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THE MECHANICAL PROPERTY DATA BASE FROM AN AIR FORCE/INDUSTRY COOPERATIVE TEST PROGRAM ON ADVANCED ALUMINUM ALLOYS (WELDALITE™ 049 RX815 PLATE (2095-T8))

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May 1993

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This report contains the development of mechanical property data base on aluminum-lithium alloy Weldalite™ 049 0.5-inch plate. Basic mechanical property data consist of tension, compression, bearing, shear, and fracture toughness properties. Fatigue data were developed for both smooth and notched specimens. Constant amplitude fatigue crack growth rate data and spectrum fatigue test data were generated. Other tests performed on the material were ballistic, hardness, and conductivity.

14. SUBJECT TERMS
Weldalite™ 049, 8090, Tensile, Bearing, Spectrum, Aluminum-Lithium, AL905XL, Compression, Fatigue Crack Growth, 2095, 2091, IN905XL, Shear, Fracture Toughness

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PREFACE

This report was prepared by the Materials Engineering Branch (WL/MLSE), Systems Support Division, Materials Directorate, Wright Laboratory, Wright-Patterson Air Force Base, Ohio, under Project 2418, "Metallic Structural Materials," Task 241807, "Systems Support," Work Unit 24180703, "Engineering and Design Data."

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SECTION I

INTRODUCTION

High performance aerospace systems are dependent on materials that are lighter, have improved mechanical properties, and/or offer a cost savings. Aluminum alloys that met these criteria were the newly developed aluminum-lithium alloys and the second generation powder metallurgy alloys.

In 1985, the Air Force along with the aerospace community found it important to investigate the potential of these promising aluminum alloys. A cooperative program was formed by the Wright Laboratory Materials Directorate, Systems Support Division, and a number of aerospace industries. The Air Force would obtain the test material from the producers, compile the test data, and submit reports to the participants. The participants agreed to support the program by performing mechanical property tests which includes tension, compression, bearing, shear, fracture toughness, and fatigue related properties (S/N, da/dn). The Air Force elected to perform spectrum fatigue crack growth testing on most alloys. A list of participants is shown in the following table.

This interim report contains the aluminum-lithium alloy Weldalite™ 049 RX815 0.5-inch-thick plate produced by Reynolds Metals Company. The Weldalite™ 049 RX815 alloy has been registered as 2095 with the Aluminum Association. Comparisons to other materials, and ranking of materials are generally avoided since each potential application may be based on different evaluation criteria.

TABLE

Participants and Advanced Aluminum Alloys in the Cooperative Test Program

PARTICIPANTS	ALUMINUM LITHIUM ALLOYS													P/M ALUMINUM ALLOYS					
	PECHINEY				ALCAN		IncoMAP		ALCOA				REYNOLDS	KAISER		ALCOA			
	2091 – T3 Sheet (0.063"T)	2091 – T351 Plate (0.420"T)	2091 – T6 Forging	8090 – T651 T Extrusion	8090 – T651 Extrusion	8090 – T8771 Plate (1.75"T)	PM IN905XL Forging	PM AL905XL Forging	2091 – T3 Sheet (0.063"T)	2091 – T3 Sheet (0.144"T)	2091 – T8 Plate (0.50"T)	8090 Extrusion	Weldalite 049 RX815 Plate (0.5"T)	7064 – T74511 Extrusion	7064 – T74 Forging	CW67 Sheet (0.063"T)	CW67 Plate (0.40"T)	CW67 Extrusion	CW67 Forging
Air Force WPAFB, OH		x			x	x	x	x	x	x	x	x	x	x	x			x	x
Army, MA												x	x						
AVCO, TN									x										
Boeing, WA	x	x	x	x															
Douglas Aircraft, CA								x	x	x	x	x	x						
General Dynamics, CA	x	x							x	x	x		x						
General Dynamics, TX	x	x	x	x			x		x	x	x	x							
Grumman Aerospace, NY	x	x			x		x							x	x			x	x
Jet Propulsion, CA								x					x						
Lockheed, CA	x			x				x	x		x								
Lockheed, GA			x		x				x	x					x				x
LTV, TX	x			x			x	x	x			x		x	x			x	
Martin Marietta, LA	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x
McDonnell Douglas Astro, CA										x			x						
McDonnell Douglas Helicopter, AR								x											
McDonnell Douglas Missile Sys, MO													x						
McDonnell Aircraft, MO	x						x	x	x						x	x			x
NASA, VA					x		x	x					x						
Naval Air Development Center		x		x				x			x								x
Northrop, CA	x	x	x		x	x	x	x	x	x	x	x	x						
Sikorsky, CT							x		x						x		x		x
Sundstrand, IL													x						
Wyman–Gordon								x											

SECTION II

MATERIALS AND TESTS

The Weldalite™ 049 RX815 (2095) 0.5-inch-thick plate was received the first quarter of 1991. The 2095 was received in the T8 condition. This alloy is considered to be a damage tolerant, medium strength aluminum-lithium alloy. A chemical analysis was performed on the 2095 and the alloy chemistry is shown below.

Element	Weight %	Element	Weight %
Copper	4.17	Iron	0.057
Lithium	1.30	Nickel	0.0030
Magnesium	0.339	Titanium	0.028
Silicon	0.038	Zirconium	0.126
Silver	0.334	Aluminum	Balance

Basic mechanical properties (tension, compression, bearing, etc) were tested according to ASTM standards, unless otherwise specified. General Dynamics generated hardness and conductivity data. Constant amplitude fatigue crack growth tests were conducted according to ASTM E647 standard. Northrop Corporation performed constant amplitude fatigue crack growth test using K controlled methods. A T-38 LIF (lead-in-fighter) spectrum test was performed by Northrop Corporation. The spectrum specimen was not precracked but contained a countersunk hole to simulate a crack initiating from a fastener hole. The Army evaluated the ballistic performance of the material. The Army and Northrop Corporation have corrosion tests in process.

SECTION III

PRESENTATION

Each participant compiled a data package which contained the data they generated. Some of these data packages contain discussions, and in other cases, only the data were provided. The tensile, compression, bearing, shear, and fracture toughness data from each package were put in tabular form. Fatigue, fatigue crack growth, spectrum fatigue crack growth, hardness, and conductivity data were placed in tabular and graphical form. Ballistic performance data were put in text and graphical form.

SECTION IV

RESULTS AND DISCUSSION

The data generated by the participants on the 2095-T8 0.5 inch thick plate are shown in Tables I1 thru I36 and Figures I1 thru I15.

TABLE I1

TENSILE RESULTS AT t/2 LOCATION FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	TEST TEMP (DEGREES F)	ORIENT-ATION	ULTIMATE STRENGTH (KSI)	YIELD STRENGTH (KSI)	ELONG (%)	RA (%)	E (MSI)
MCDONNELL DOUGLAS, MO	RT	LONG	89.7	85.7	12.0	23.7	10.9
			88.4	84.3	12.0	19.7	10.8
			86.8	81.1	12.0	26.4	11.4
SUNDSTRAND	RT	LONG	89.4	83.4	13.1	19.2	
			89.4	81.2	12.8	20.1	
			89.9	83.7	13.0	19.3	
ARMY-MTL	RT	LONG	88.6	81.9	12.9		10.8
			88.2	81.3	11.7		10.9
			87.7	80.4	12.9		10.4
GENERAL DYNAMICS	RT	LONG	88.1	82.5	10.7	17.1	11.0
			89.2	84.9	11.0	21.3	11.0
			89.1	84.6	10.0	17.6	11.2
NASA-LANGLEY	RT	LONG	88.0	81.2	12.3		11.2
			84.9	75.6	9.6		11.3
			85.0	77.2	9.6		11.3
NORTHROP	RT	LONG	89.7	83.6	13.9		11.5
			88.1	80.6	13.0		11.1
			89.0	81.8	13.6		11.0
AIR FORCE(*)	RT	LONG	89.4	83.1	7.4	27.0	
MCDONNELL DOUGLAS, CA	RT	LONG	84.0	77.9	12.0		
			82.5	76.0	13.0		
			82.7	77.1	10.0		
		AVERAGE	87.6	81.3	11.7	21.1	11.1
	STANDARD DEVIATION		2.1	2.9	1.6	3.5	0.3

(*): TEST SECTION DIAMETER = 0.16"

TABLE I2

TENSILE RESULTS AT t/2 LOCATION FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	TEST TEMP (DEGREES F)	ORIENT-ATION	ULTIMATE STRENGTH (KSI)	YIELD STRENGTH (KSI)	ELONG (%)	RA (%)	E (MSI)
MCDONNELL DOUGLAS, MO	RT	L TRANS	87.0	80.8	11.0	23.8	11.1
			87.0	81.1	11.0	26.8	10.8
			86.8	80.8	11.0	28.4	10.9
SUNDSTRAND	RT	L TRANS	86.3	79.0	12.0	25.1	
			85.8	78.3	12.7	25.7	
			86.2	79.2	13.4	27.3	
ARMY-MTL	RT	L TRANS	84.7	75.4	14.1		10.8
			85.6	76.8	13.6		10.2
			84.9	75.7	15.0		10.7
GENERAL DYNAMICS	RT	L TRANS	84.0	75.6	11.4	21.9	11.0
			86.1	79.1	11.0	22.1	10.7
			83.8	75.4	11.0	29.7	10.8
NASA-LANGLEY	RT	L TRANS	84.8	76.4		13.1	11.3
			87.2	80.1		9.1	11.1
			87.3	80.3		14.5	11.2
NORTHROP	RT	L TRANS	85.7	75.9	14.7		11.6
			87.0	78.5	14.6		11.6
			85.2	75.3	15.5		11.1
AIR FORCE(*)	RT	L TRANS	88.9	82.4	8.8	31.0	
MCDONNELL DOUGLAS, CA	RT	L TRANS	81.2	71.7	14.5		
			80.5	71.0	14.5		
			81.8	73.0	14.0		
		AVERAGE	85.4	77.4	12.8	23.0	11.0
	STANDARD DEVIATION		2.1	3.1	1.9	6.8	0.4

(*): TEST SECTION DIAMETER = 0.16"

TABLE I3

TENSILE RESULTS AT t/2 LOCATION FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	TEST TEMP (DEGREES F)	ORIENT-ATION	ULTIMATE STRENGTH (KSI)	YIELD STRENGTH (KSI)	ELONG (%)	RA (%)	E (MSI)
MCDONNELL	RT	45	77.0	70.6	14.0	36.6	11.4
DOUGLAS			77.2	70.1	16.0	39.1	10.9
			76.3	69.2	17.0	39.3	10.8
AIR FORCE(*)	RT	45	75.5	69.0	8.9	41.7	9.9
		AVERAGE	76.5	69.7	14.0	39.2	10.8
	STANDARD DEVIATION		0.8	0.8	3.6	2.1	0.6

(*): TEST SECTION DIAMETER = 0.16"

TABLE I4

TENSILE RESULTS AT t/2 LOCATION FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	TEST TEMP (DEGREES F)	ORIENT-ATION	ULTIMATE STRENGTH (KSI)	YIELD STRENGTH (KSI)	ELONG (%)	RA (%)	E (MSI)
AIR FORCE	-321(*)	LONG	108.0	97.5		22.0	12.0
		L TRANS	104.0	93.8	9.6	26.0	11.7
	-150	45	95.4	89.9	12.6	25.0	11.0
	-100(*)	LONG	92.3	86.2	8.8	27.0	11.0
		45	78.7	71.5	11.4	21.6	11.5
		L TRANS	91.9	85.0	8.0	26.0	
	-40	45	90.2	83.1	12.3	25.3	10.1
	0	45	89.2	82.2	11.1	22.6	10.0
	150	45	87.5	82.9	11.4	29.2	11.4
			88.7	84.8	11.9	27.7	11.4
	200	45	78.9	78.1	16.4	47.3	10.7
			79.7	78.6	17.2	47.8	11.5

(*): TEST SECTION DIAMETER = 0.16"

TABLE I5

TENSILE RESULTS AT t/2 LOCATION FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")
(1000 HR EXPOSURE @ 350F)

COMPANY	TEST TEMP (DEGREES F)	ORIENT-ATION	ULTIMATE STRENGTH (KSI)	YIELD STRENGTH (KSI)	ELONG (%)	RA (%)	E (MSI)
AIR FORCE	RT	45	70.4	58.3	8.1	22.9	11.2
			70.1	58.0	8.2	23.8	11.3
		AVERAGE	70.3	58.1	8.2	23.3	11.2
		STANDARD DEVIATION	0.2	0.2	0.1	0.6	0.1

TABLE I6

COMPRESSION RESULTS AT t/2 LOCATION FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	TEST TEMPERATURE (DEGREES F)	ORIENTATION	COMPRESSIVE YIELD STRENGTH (KSI)	COMPRESSIVE MODULUS (MSI)
MCDONNELL DOUGLAS, MO	RT	LONG	73.8	11.1
			75.3	10.9
			76.1	11.1
SUNDSTRAND	RT	LONG	73.1	12.0
			73.3	11.8
			73.8	11.7
GENERAL DYNAMICS	RT	LONG	77.0	11.3
			79.0	11.6
			80.0	11.4
NASA-LANGLEY	RT	LONG	62.3	11.4
NORTHROP	RT	LONG	70.9	12.2
			72.2	12.1
			76.7	11.9
MCDONNELL DOUGLAS, CA	RT	LONG	68.1	11.0
			69.1	11.5
			69.6	11.7
		AVERAGE	73.1	11.6
		STANDARD DEVIATION	4.5	0.4

TABLE I7

COMPRESSION RESULTS AT t/2 LOCATION FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	TEST TEMPERATURE (DEGREES F)	ORIENTATION	COMPRESSIVE YIELD STRENGTH (KSI)	COMPRESSIVE MODULUS (MSI)
MCDONNELL DOUGLAS, MO	RT	L TRANS	79.5	11.8
			78.5	11.8
			79.1	11.6
SUNDSTRAND	RT	L TRANS	79.4	11.6
			79.0	11.5
			77.6	12.7
GENERAL DYNAMICS	RT	L TRANS	79.2	11.4
			80.6	11.6
			80.4	12.0
NASA-LANGLEY	RT	L TRANS	75.1	11.4
			77.0	11.5
			76.0	11.4
NORTHROP	RT	L TRANS	79.4	11.9
			75.9	12.1
			73.5	12.2
MCDONNELL DOUGLAS, CA	RT	L TRANS	72.9	14.0
			72.3	13.5
			73.2	13.8
		AVERAGE	77.1	12.1
		STANDARD DEVIATION	2.8	0.8

TABLE I8

COMPRESSION RESULTS AT t/2 LOCATION FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	TEST TEMPERATURE (DEGREES F)	ORIENTATION	COMPRESSIVE YIELD STRENGTH (KSI)	COMPRESSIVE MODULUS (MSI)
MCDONNELL	RT	45	70.5	11.1
DOUGLAS			70.3	11.0
			72.2	10.9
		AVERAGE	71.0	11.0
		STANDARD DEVIATION	1.0	0.1

TABLE I9

COMPRESSION RESULTS AT t/2 LOCATION FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	TEST TEMPERATURE (DEGREES F)	ORIENTATION	COMPRESSIVE ULT STRENGTH (KSI)	COMPRESSIVE MODULUS (MSI)
ARMY-MTL	RT	LONG	111.2	
			107.2	
			110.7	
		AVERAGE	109.7	
		STANDARD DEVIATION	2.2	
ARMY-MTL	RT	L TRANS	115.4	
			119.0	
			114.7	
		AVERAGE	116.4	
		STANDARD DEVIATION	2.3	

TABLE I10

PIN SHEAR RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	SHEAR STRENGTH (KSI)
ARMY-MTL	LONG	49.5
		48.8
		49.7
NORTHROP	LONG	45.7
		46.6
		46.0
	AVERAGE	47.7
	STANDARD DEVIATION	1.8

TABLE I11

RIVET SHEAR RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	SHEAR STRENGTH (KSI)
ARMY-MTL	L TRANS	49.0
		48.5
		47.7
	AVERAGE	48.4
	STANDARD DEVIATION	0.7

TABLE I12

TORSIONAL SHEAR RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	SHEAR STRENGTH (KSI)
SUNDSTRAND	LONG	47.1
		46.4
		45.1
	AVERAGE	46.2
	STANDARD DEVIATION	1.0
SUNDSTRAND	L TRANS	45.4
		45.1
		46.8
	AVERAGE	45.8
	STANDARD DEVIATION	0.9

TABLE I13

AMSLER DOUBLE SHEAR RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	SHEAR STRENGTH (KSI)
NASA-LANGLEY	L-S	44.4
		46.3
		47.7
	AVERAGE	46.1
	STANDARD DEVIATION	1.7
NASA-LANGLEY	T-S	47.5
		45.6
		45.0
	AVERAGE	46.0
	STANDARD DEVIATION	1.3

TABLE I14

BEARING RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	e/D	BEARING ULT. STR. (KSI)	BEARING YIELD STR. (KSI)
MCDONNELL DOUGLAS, MO	LONG	1.5	128.0	106.0
			119.0	100.0
			122.0	103.0
NASA-LANGLEY	LONG	1.5	123.1	99.2
			119.4	98.4
			120.6	100.3
NORTHROP	LONG	1.5	156.4	116.5
			154.3	114.3
			153.6	113.7
MCDONNELL DOUGLAS, CA	LONG	1.5	120.2	102.1
			121.1	101.9
			121.1	101.5
		AVERAGE	129.9	104.7
		STANDARD DEVIATION	15.2	6.4

TABLE I15

BEARING RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	e/D	BEARING ULT. STR. (KSI)	BEARING YIELD STR. (KSI)
MCDONNELL DOUGLAS, MO	45	1.5	128.0	106.0
			131.0	110.0
			135.0	111.0
		AVERAGE	131.3	109.0
		STANDARD DEVIATION	3.5	2.6

TABLE I16

BEARING RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	e/D	BEARING ULT. STR. (KSI)	BEARING YIELD STR. (KSI)
MCDONNELL DOUGLAS, MO	L TRANS	1.5	125.0	106.0
			129.0	105.0
			131.0	107.0
NASA-LANGLEY	L TRANS	1.5	122.2	98.4
			124.2	101.6
			124.7	99.4
NORTHROP	L TRANS	1.5	158.7	121.1
			160.4	120.6
			160.2	128.5
MCDONNELL DOUGLAS, CA	L TRANS	1.5	121.7	100.4
			121.7	98.3
			120.5	97.3
		AVERAGE	133.3	107.0
		STANDARD DEVIATION	16.3	10.6

TABLE I17

BEARING RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	e/D	BEARING ULT. STR. (KSI)	BEARING YIELD STR. (KSI)
MCDONNELL DOUGLAS, MO	LONG	2.0	164.0	128.0
			159.0	131.0
			158.0	130.0
NASA-LANGLEY	LONG	2.0		114.5
			148.0	111.0
			146.7	112.3
NORTHROP	LONG	2.0	183.1	120.6
			183.6	123.1
			182.5	122.7
MCDONNELL DOUGLAS, CA	LONG	2.0	157.5	119.6
			156.5	124.1
			157.4	120.2
		AVERAGE	163.3	121.4
		STANDARD DEVIATION	13.6	6.5

TABLE I18

BEARING RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	e/D	BEARING ULT. STR. (KSI)	BEARING YIELD STR. (KSI)
MCDONNELL DOUGLAS, MO	45	2.0	172.0	141.0
			166.0	136.0
			169.0	138.0
		AVERAGE	169.0	138.3
		STANDARD DEVIATION	3.0	2.5

TABLE I19

BEARING RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	e/D	BEARING ULT. STR. (KSI)	BEARING YIELD STR. (KSI)
MCDONNELL DOUGLAS, MO	L TRANS	2.0	163.0	132.0
			160.0	137.0
			166.0	137.0
NASA-LANGLEY	L TRANS	2.0		116.4
			154.5	116.6
			154.5	116.1
NORTHROP	L TRANS	2.0	186.9	126.7
			188.5	131.2
			189.8	127.5
MCDONNELL DOUGLAS, CA	L TRANS	2.0	155.4	122.1
			158.9	124.6
			156.8	122.9
		AVERAGE	166.8	125.8
		STANDARD DEVIATION	14.4	7.5

TABLE I20

FRACTURE TOUGHNESS RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	KIC (KSI in^0.5)	Kq (KSI in^0.5)	COMMENT
MCDONNELL	L-T		26.3	(1)
DOUGLAS			22.8	(2)
SUNDSTRAND	L-T	30.2		
		30.0		
ARMY-MTL	L-T	26.8		
			37.3	(2),(3)
			33.3	(2)
			36.4	(2),(3)
			33.7	(2)
GENERAL	L-T		33.5	(2)
DYNAMICS			30.7	(2)
			30.1	(2)
NASA-LANGLEY	L-T	27.0		
			25.3	(2)
NORTHROP	L-T		37.7	(3)
			40.4	(3)
			43.3	(3)
	AVERAGE	28.5	33.1	
	STANDARD DEVIATION	1.8	6.0	

(1): INVALID DUE TO SURFACE CRACK LENGTH MEASUREMENTS EXCEEDED 10% OF AVERAGE CRACK LENGTH

(2): INVALID DUE TO Pmax/Pq > 1.10

(3): INVALID DUE TO a & B > 2.5(Kq/YS)**2

TABLE I21

FRACTURE TOUGHNESS RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	KIC (KSI in^0.5)	Kq (KSI in^0.5)	COMMENT
MCDONNELL	T-L		25.8	(1)
DOUGLAS		29.6		
SUNDSTRAND	T-L	29.1		
		29.0		
ARMY-MTL	T-L		40.2	(2),(3)
			35.6	(3)
			35.0	(2),(3)
			35.9	(2),(3)
			36.9	(2),(3)
			35.5	(3)
GENERAL	T-L	31.4		
DYNAMICS			29.4	(2)
			29.2	(2)
NASA-LANGLEY	T-L	24.4		
NORTHROP	T-L		38.7	(3)
			38.3	(3)
			37.9	(3)
	AVERAGE	28.7	34.9	
	STANDARD DEVIATION	2.6	4.4	

(1): INVALID DUE TO SURFACE CRACK LENGTH MEASUREMENTS EXCEEDED 10% OF AVERAGE CRACK LENGTH

(2): INVALID DUE TO Pmax/Pq > 1.10

(3): INVALID DUE TO a & B > 2.5(Kq/YS)**2

TABLE I22

FRACTURE TOUGHNESS RESULTS FOR REYNOLDS
2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	KIC (KSI in^0.5)	Kq (KSI in^0.5)	COMMENT
MCDONNELL	45		25.4	(1)
DOUGLAS		23.6		

(1): INVALID DUE TO SURFACE CRACK LENGTH MEASUREMENTS EXCEEDED 10% OF AVERAGE CRACK LENGTH

TABLE I23

Hardness & Conductivity Results for 2095-T8
0.5 Inch Plate. General Dynamics, CA

Alloy/Product Form	Hardness (R_B Scale)	Conductivity (% IACS)
Weldalite 2095-T8 0.50 Inch Plate	See Figure	22 (a) 17 (b)
(a) as received mill surface (b) machined surface		

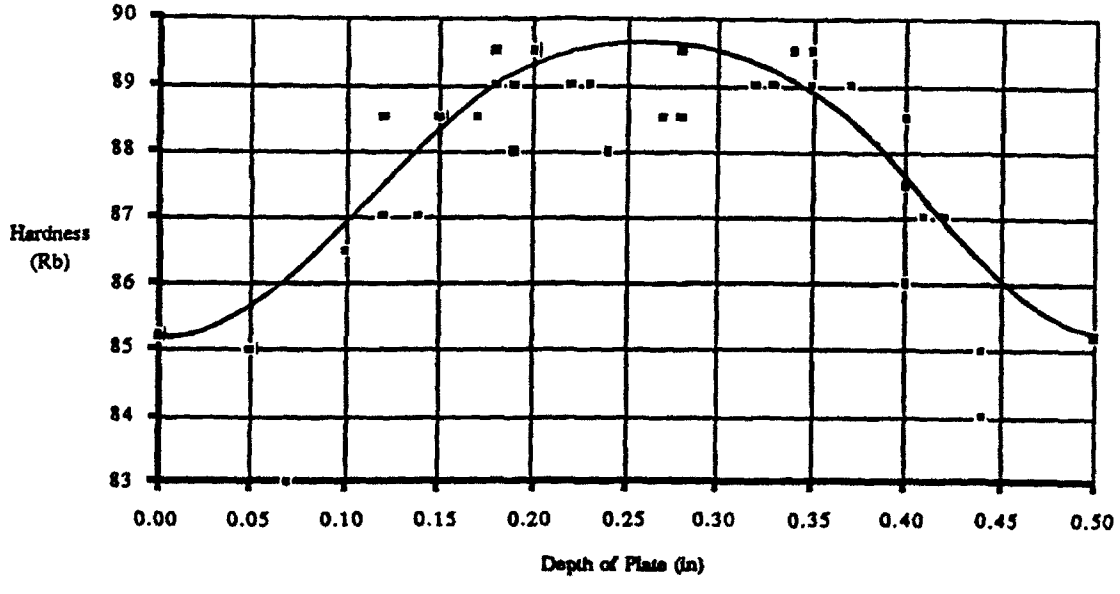
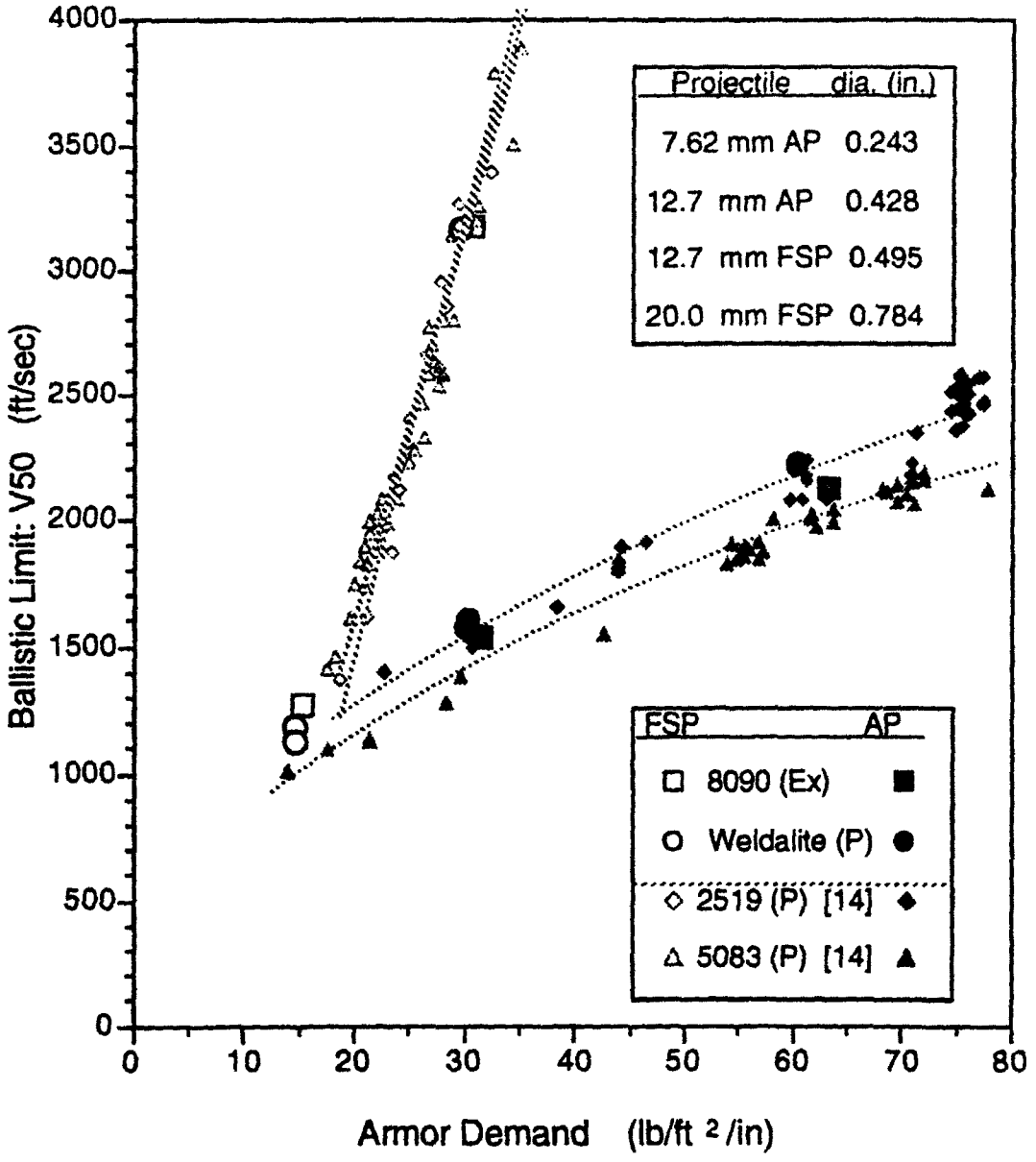


Figure I1. Hardness profile through 2095-T8
0.5 Inch Plate. General Dynamics, CA.



Both 8090 extrusions (Ex) and Weldalite plates (P) provided enhanced ballistic performance over 2519 and 5083 Al alloys. The V_{50} ballistic limits against AP and FSP projectiles at 0° obliquity are plotted versus Armor demand. The Armor demand is defined as the (density x thickness) / projectile diameter. The ballistic data for different caliber projectiles superimpose on single curves for either AP or FSP projectiles when plotted against armor demand. This technique allows designers to evaluate ballistic performance as a function of projectile type rather than for individual munitions. The AP and FSP projectile diameters are included as inserts in the plot. Ballistic data for 2519 and 5083 are included as the high and low ends of aluminum alloys currently being considered for structural armor applications. The lower set of 8090 and Weldalite data points for both AP and FSP projectiles represent 0.5 inch ballistic targets. The second series of data points for each projectile type represent stacked plates to provide 1.0 inch thickness. The ballistic limits of both AL-Li alloys are attributed to the witness plate being perforated by spalling rather than by the projectile exiting the target.

Figure I2. Ballistic limit (V_{50}) verses Armor Demand at 0° obliquity against Armor Piercing (AP) and Fragment Simulating Projectiles (FSP). Army.

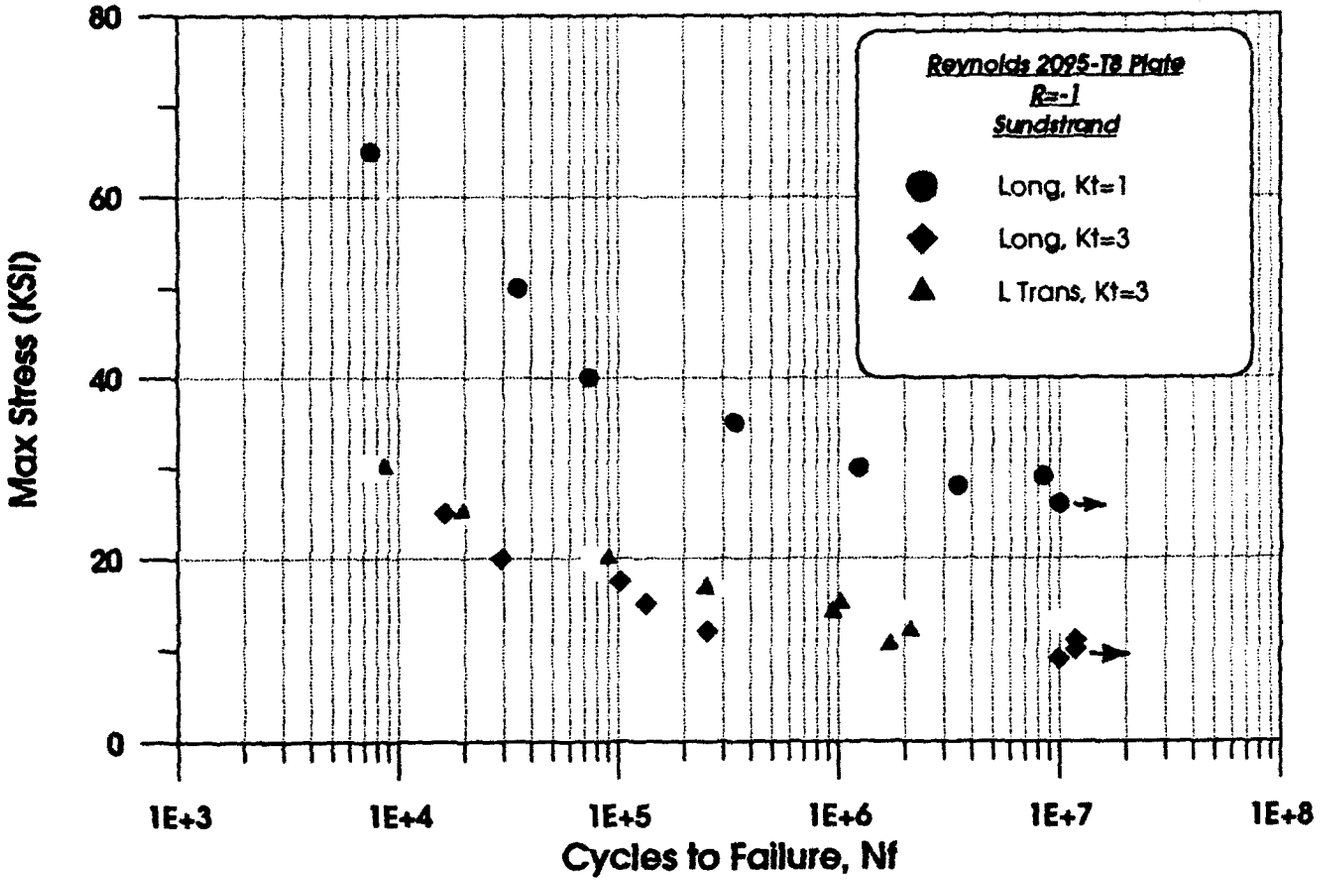


Figure I3. Fatigue Results for 2095-T8 0.5 Inch Plate (R = -1, Kt = 1.0 and Kt = 3.0) and 2095-T6 (R = -1 and Kt = 3)

TABLE I24

FATIGUE RESULTS WITH R=-1.0 AND Kt=1.0 FOR
REYNOLDS 2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	STRESS (KSI)	CYCLES
SUNDSTRAND	LONG	65.0	7,500
		50.0	34,950
		40.0	73,820
		35.0	338,910
		30.0	1,240,950
		29.0	8,461,080
		28.0	3,489,830
		26.0	10,000,000 *

(*): RUN OUT

TABLE I25

FATIGUE RESULTS WITH R=-1.0 AND Kt=3.0 FOR
REYNOLDS 2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	STRESS (KSI)	CYCLES
SUNDSTRAND	LONG	25.0	16,300
		20.0	29,460
		17.5	102,580
		15.0	133,920
		12.0	253,810
		11.0	11,796,000 *
		10.0	11,913,000 *
		9.0	10,000,000 *

(*): RUN OUT

TABLE I26

FATIGUE RESULTS WITH R=-1.0 AND Kt=3.0 FOR
REYNOLDS 2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	STRESS (KSI)	CYCLES
SUNDSTRAND	L TRANS	30.0	8,620
		25.0	19,690
		20.0	90,000
		17.0	254,530
		15.0	1,024,210
		14.0	943,790
		12.0	2,110,280
		10.5	1,715,500

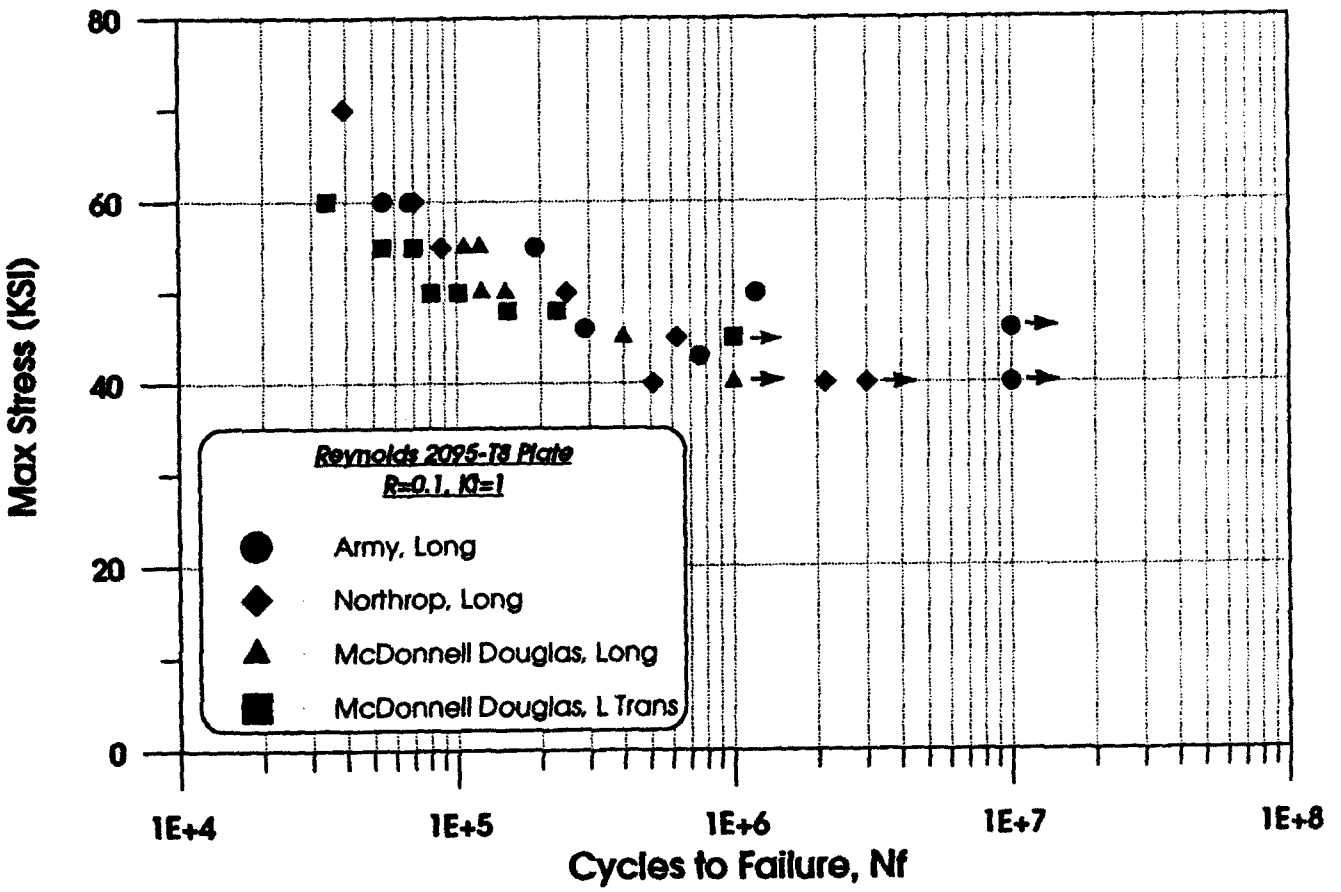


Figure I4. Fatigue Results for 2095-T8 0.5 Inch Plate (R = 0.1 and Kt = 1.0)

TABLE I27

FATIGUE RESULTS WITH R=0.1 AND Kt=1.0 FOR
REYNOLDS 2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	STRESS (KSI)	CYCLES
ARMY-MTL	LONG	60.0	54,220
		60.0	67,580
		55.0	191,520
		50.0	1,205,760
		46.0	290,042
		46.0	10,026,880 *
		43.0	754,000
		40.0	10,010,000 *
NORTHROP	LONG	70.0	39,420
		60.0	70,550
		55.0	87,944
		50.0	247,950
		45.0	623,760
		40.0	511,870
		40.0	3,000,000 *
		40.0	2,135,840
MCDONNELL DOUGLAS, CA	LONG	55.0	106,010
		55.0	120,950
		50.0	149,620
		50.0	122,970
		45.0	398,910
		45.0	398,300
		40.0	1,000,000 *
		40.0	1,000,000 *
MCDONNELL DOUGLAS, CA	L TRANS	60.0	34,170
		55.0	53,870
		55.0	69,800
		50.0	101,060
		50.0	80,470
		48.0	153,080
		48.0	229,570
		45.0	1,000,000 *
		45.0	1,000,000 *

(*): RUN-OUT

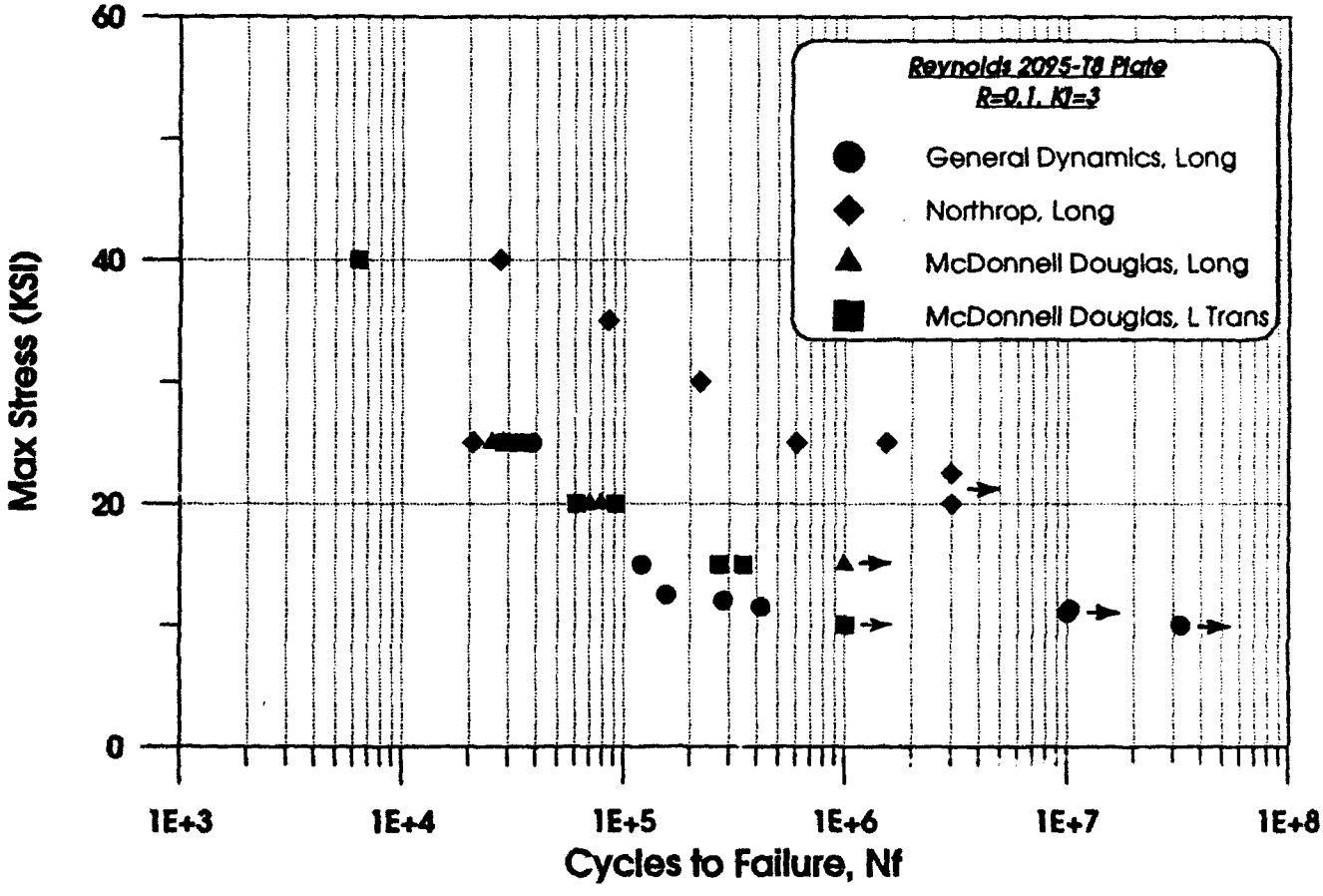


Figure I5. Fatigue Results for 2095-T8 0.5 Inch Plate (R = 0.1 and Kt = 3)

TABLE I28

FATIGUE RESULTS WITH R=0.1 AND Kt=3.0 FOR
REYNOLDS 2095-T8 PLATE (0.5" X 24" X 48")

COMPANY	ORIENTATION	STRESS (KSI)	CYCLES
GENERAL DYNAMICS	LONG	25.0	38,200
		15.0	120,600
		12.5	155,500
		12.0	281,900
		11.5	417,100
		11.3	10,240,300 *
		11.0	10,000,000 *
		10.0	32,313,000 *
NORTHROP	LONG	40.0	27,530
		35.0	84,820
		30.0	220,840
		25.0	20,830
		25.0	605,470
		25.0	1,535,480
		22.5	3,000,000 *
		20.0	3,000,000 *
MCDONNELL DOUGLAS, CA	LONG	25.0	28,540
		25.0	25,320
		20.0	78,410
		20.0	69,950
		15.0	1,000,000 *
		15.0	1,000,000 *
		10.0	1,000,000 *
		10.0	1,000,000 *
MCDONNELL DOUGLAS, CA	L TRANS	40.0	6,331
		25.0	28,860
		25.0	32,940
		20.0	60,520
		20.0	91,030
		15.0	348,180
		15.0	271,490
		10.0	1,000,000 *
		10.0	1,000,000 *

(*): RUN-OUT

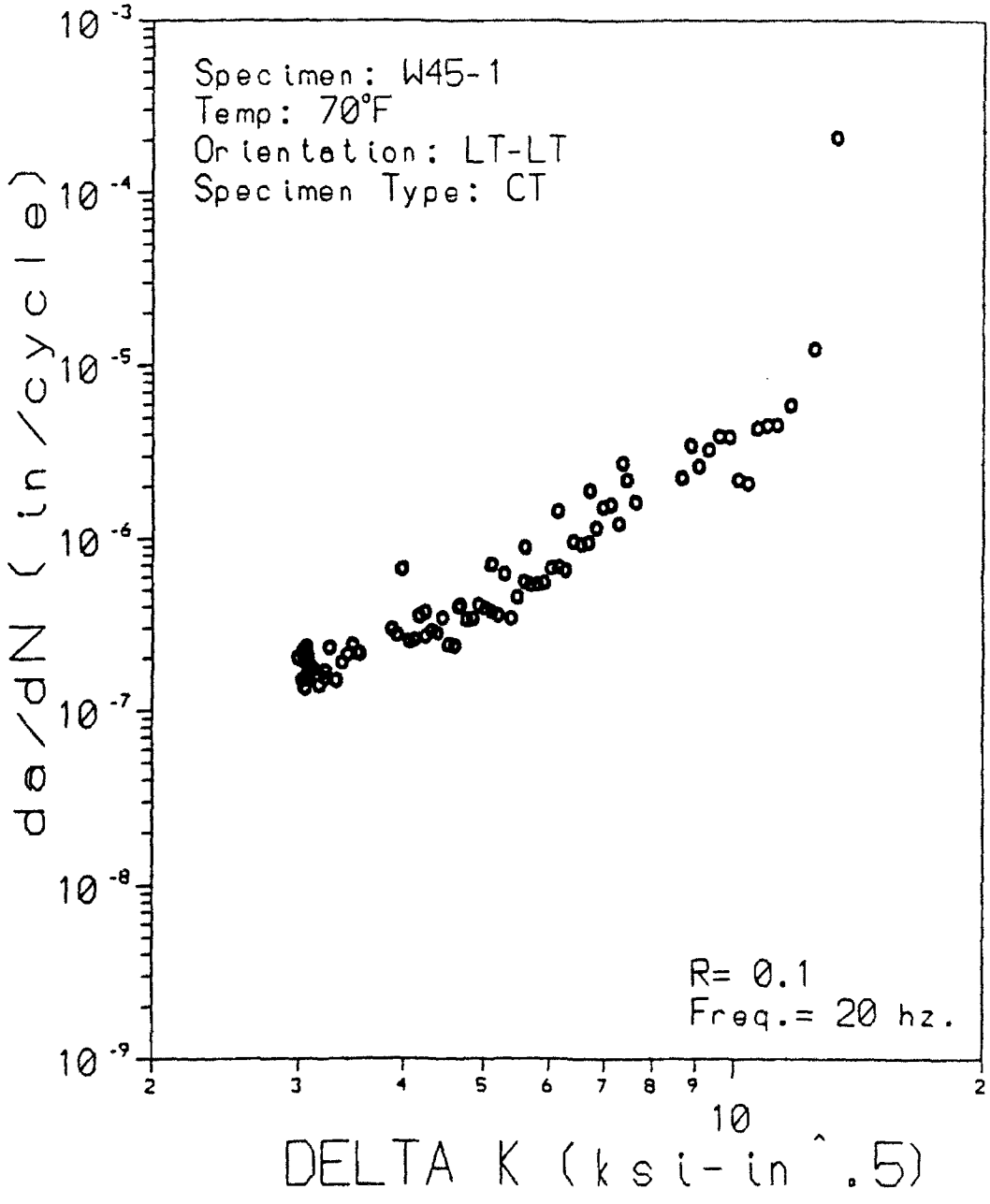


Figure I6. Fatigue Crack Growth Rate Data for 2095-T8 0.5 Inch Plate (LT-LT orientation, Specimen W45-1). Air Force.

TABLE I29

Fatigue Crack Growth Data Associated with Figure I6

W45-1.DAT

W= 2.003 in
B= 0.249 in

a (in)	N (kilocycles)	da/dN (in/kcyc)	daK (ksi-in^.5)	Pmax (lbs)	a(c) (in)	N (kilocycles)	da/dN(c) (in/cyc)	daK(c) (ksi-in^.5)
0.5339	0.0	0.0000	7.23	550	0.5339	0.0		
0.5471	4.8	2.1053	7.31	550	0.5472	4.8	2.77E-06	7.36
0.5572	10.1	1.8765	6.67	495	0.5574	10.1	1.92E-06	6.71
0.5675	17.3	1.4382	6.06	446	0.5678	17.3	1.45E-06	6.13
0.5775	28.7	0.8745	5.55	401	0.5780	28.7	8.93E-07	5.59
0.5876	43.3	0.6907	5.06	361	0.5883	43.3	7.08E-07	5.10
0.5977	69.6	0.3857	4.61	325	0.5988	69.6	4.00E-07	4.65
0.6078	109.2	0.2544	4.20	292	0.6095	109.2	2.71E-07	4.24
0.6178	144.6	0.2840	3.83	263	0.6201	144.6	2.98E-07	3.87
0.6279	195.6	0.1968	3.50	237	0.6310	195.6	2.14E-07	3.54
0.6379	261.4	0.1530	3.19	213	0.6421	261.4	1.68E-07	3.22
0.6482	327.9	0.1539	3.07	202	0.6534	327.9	1.71E-07	3.10
0.6582	381.9	0.1861	2.95	192	0.6643	381.9	2.01E-07	2.99
0.6683	457.1	0.1338	2.99	192	0.6756	457.1	1.50E-07	3.03
0.6784	541.8	0.1193	2.99	190	0.6870	541.8	1.35E-07	3.05
0.6885	589.8	0.2101	2.99	187	0.6979	589.8	2.26E-07	3.04
0.6985	641.8	0.1942	2.99	185	0.7087	641.8	2.09E-07	3.05
0.7085	694.7	0.1883	2.99	182	0.7196	694.7	2.04E-07	3.04
0.7187	754.2	0.1712	2.99	180	0.7307	754.2	1.87E-07	3.05
0.7288	800.5	0.2166	2.99	178	0.7416	800.5	2.34E-07	3.06
0.7388	872.9	0.1387	2.99	175	0.7527	872.9	1.54E-07	3.05
0.7488	943.3	0.1420	2.99	173	0.7638	943.3	1.58E-07	3.06
0.7589	995.6	0.1933	2.99	171	0.7748	995.6	2.09E-07	3.07
0.7689	1054.6	0.1702	2.99	169	0.7857	1054.6	1.85E-07	3.08
0.7789	1117.7	0.1586	2.99	167	0.7967	1117.7	1.74E-07	3.09
0.7890	1191.2	0.1370	2.99	164	0.8080	1191.2	1.53E-07	3.08
0.7991	1256.1	0.1546	3.03	164	0.8191	1256.1	1.72E-07	3.12
0.8091	1337.3	0.1233	3.07	164	0.8304	1337.3	1.39E-07	3.17
0.8192	1411.1	0.1370	3.11	164	0.8417	1411.1	1.53E-07	3.22
0.8292	1457.8	0.2156	3.15	164	0.8524	1457.8	2.31E-07	3.26
0.8394	1534.5	0.1323	3.19	164	0.8638	1534.5	1.49E-07	3.32
0.8494	1592.1	0.1743	3.23	164	0.8748	1592.1	1.90E-07	3.37
0.8595	1644.4	0.1918	3.28	164	0.8857	1644.4	2.09E-07	3.42
0.8695	1689.1	0.2253	3.32	164	0.8964	1689.1	2.40E-07	3.47
0.8796	1739.2	0.2007	3.37	164	0.9073	1739.2	2.18E-07	3.52
0.8896	1777.5	0.2628	3.74	180	0.9179	1777.5	2.77E-07	3.92
0.8996	1793.1	0.6496	3.79	180	0.9284	1793.1	6.70E-07	3.98
0.9096	1835.3	0.2369	3.85	180	0.9390	1835.3	2.53E-07	4.05
0.9199	1876.8	0.2439	3.90	180	0.9498	1876.8	2.59E-07	4.11
0.9299	1906.2	0.3410	3.96	180	0.9603	1906.2	3.56E-07	4.17
0.9401	1934.6	0.3579	4.02	180	0.9709	1934.6	3.75E-07	4.24
0.9503	1971.8	0.2746	4.08	180	0.9817	1971.8	2.90E-07	4.31
0.9603	2009.1	0.2686	4.14	180	0.9923	2009.1	2.84E-07	4.38
0.9703	2039.2	0.3315	4.20	180	1.0026	2039.2	3.48E-07	4.45
0.9805	2064.5	0.2249	4.26	180	1.0137	2064.5	2.41E-07	4.52
0.9905	2130.0	0.2203	4.33	180	1.0244	2130.0	2.36E-07	4.60
1.0007	2156.0	0.3931	4.39	180	1.0350	2156.0	4.08E-07	4.68
1.0108	2187.2	0.3214	4.46	180	1.0456	2187.2	3.40E-07	4.76
1.0208	2217.5	0.3305	4.53	180	1.0561	2217.5	3.46E-07	4.84
1.0308	2242.8	0.3955	4.60	180	1.0665	2242.8	4.11E-07	4.92
1.0408	2269.4	0.3780	4.68	180	1.0769	2269.4	3.92E-07	5.01
1.0508	2297.5	0.3565	4.75	180	1.0875	2297.5	3.75E-07	5.10
1.0610	2326.8	0.3439	4.83	180	1.0981	2326.8	3.61E-07	5.19
1.0711	2343.3	0.6142	4.91	180	1.1084	2343.3	6.28E-07	5.29
1.0811	2373.7	0.3288	4.99	180	1.1189	2373.7	3.45E-07	5.38
1.0912	2396.5	0.4383	5.08	180	1.1294	2396.5	4.59E-07	5.48
1.1012	2414.8	0.5512	5.16	180	1.1397	2414.8	5.62E-07	5.59
1.1113	2434.0	0.5225	5.25	180	1.1501	2434.0	5.42E-07	5.69
1.1214	2453.1	0.5308	5.34	180	1.1605	2453.1	5.45E-07	5.80
1.1314	2471.5	0.5430	5.44	180	1.1708	2471.5	5.59E-07	5.91
1.1414	2486.8	0.6632	5.54	180	1.1810	2486.8	6.78E-07	6.03
1.1514	2501.5	0.6695	5.64	180	1.1912	2501.5	6.87E-07	6.15
1.1615	2517.2	0.6423	5.74	180	1.2016	2517.2	6.59E-07	6.27
1.1717	2528.0	0.9489	5.85	180	1.2120	2528.0	9.60E-07	6.40
1.1818	2539.0	0.9238	5.96	180	1.2222	2539.0	9.34E-07	6.54
1.1918	2549.6	0.9377	6.07	180	1.2324	2549.6	9.59E-07	6.67
1.2019	2558.4	1.1474	6.19	180	1.2427	2558.4	1.16E-06	6.82
1.2119	2565.0	1.5294	6.32	180	1.2528	2565.0	1.53E-06	6.96
1.2221	2571.5	1.5625	6.44	180	1.2631	2571.5	1.59E-06	7.11
1.2322	2579.8	1.2159	6.57	180	1.2733	2579.8	1.23E-06	7.27
1.2423	2584.4	2.1939	6.71	180	1.2835	2584.4	2.21E-06	7.44
1.2427	0.0	0.0000	6.79	180	1.2839	2589.4	9.59E-06	7.44
1.2531	6.4	1.6207	6.86	180	1.2944	2595.8	1.64E-06	7.62
1.2637	11.1	2.2319	7.79	200	1.3051	2600.5	2.27E-06	8.67
1.2738	14.0	3.4982	7.96	200	1.3153	2603.4	3.50E-06	8.86
1.2841	17.9	2.6426	8.14	200	1.3256	2607.3	2.66E-06	9.09
1.2943	21.0	3.3493	8.32	200	1.3359	2610.4	3.31E-06	9.32
1.3045	24.1	3.9264	8.53	200	1.3461	2613.5	3.95E-06	9.60
1.3178	27.0	3.9297	8.76	200	1.3565	2616.4	3.91E-06	9.87
1.3279	31.6	2.1853	8.96	200	1.3696	2621.0	2.21E-06	10.12
1.3380	36.4	2.0987	9.20	200	1.3798	2625.8	2.12E-06	10.39
1.3481	38.7	4.4262	9.42	200	1.3900	2628.1	4.41E-06	10.66
1.3581	40.9	4.5484	9.65	200	1.4000	2630.3	4.56E-06	10.95
1.3682	43.1	4.5604	9.89	200	1.4101	2632.5	4.61E-06	11.25
1.3819	45.4	6.0643	10.19	200	1.4239	2634.8	5.97E-06	11.66
1.4056	47.3	11.8333	10.69	200	1.4476	2636.7	1.25E-05	12.49
1.4263	47.4	422.4923	11.34	200	1.4683	2636.8	2.07E-04	13.27

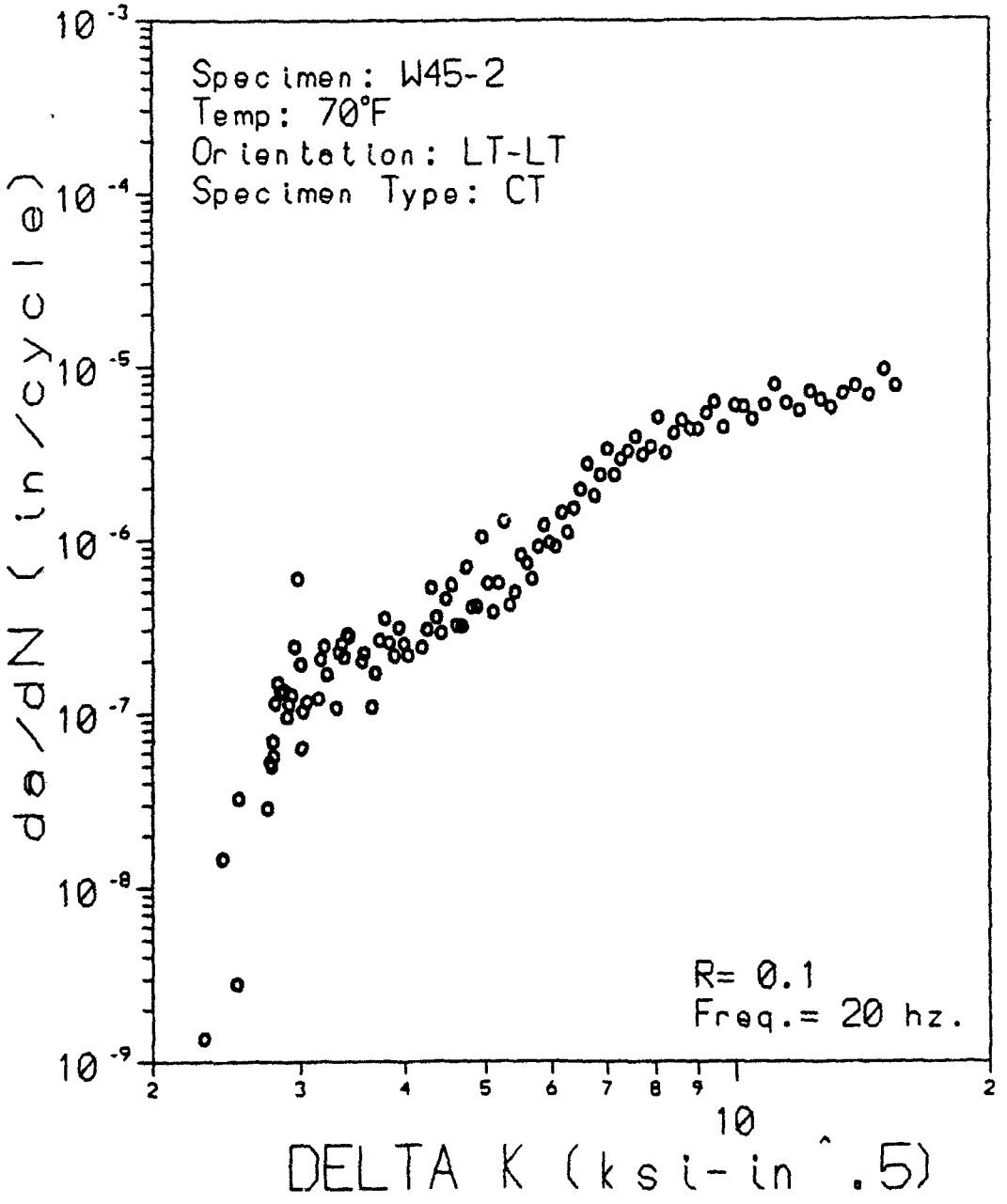


Figure I7. Fatigue Crack Growth Rate Data for 2095-T8 0.5 Inch Plate (LT-LT orientation, Specimen W45-2). Air Force.

TABLE I30

Fatigue Crack Growth Data Associated with Figure I7

W4S-2.DAT W= 2.000 in B= 0.249 in

a (in)	N (kilocycles)	da/dN (in/kcyc)	del K (ksi-in^.5)	Pmax (lbs)	a(c) (in)	N(c) (kilocycles)	da/dN(c) (in/cyc)	del K(c) (ksi-in^.5)
0.5361	0.0	0.0000	3.96	300	0.5361	0.0		
0.5481	45.7	0.2192	4.01	300	0.5480	45.7	2.16E-07	4.03
0.5541	99.4	0.1117	3.65	270	0.5538	99.4	1.09E-07	3.65
0.5602	154.3	0.1112	3.31	243	0.5597	154.3	1.09E-07	3.31
0.5663	246.2	0.0660	3.00	219	0.5656	246.2	6.34E-08	3.01
0.5723	358.2	0.0532	2.77	200	0.5712	359.2	5.02E-08	2.77
0.5783	458.1	0.0804	2.79	200	0.5770	459.1	9.71E-08	2.79
0.5843	627.3	0.0359	2.53	180	0.5825	627.3	3.27E-08	2.53
0.5904	974.2	0.0174	2.42	171	0.5875	974.2	1.47E-08	2.42
0.5964	2377.7	0.0043	2.32	162	0.5894	2377.7	1.36E-09	2.30
0.6035	4862.5	0.0029	2.55	177	0.5893	4862.5		2.51
0.6096	5961.5	0.0058	2.57	177	0.5923	5961.5	2.90E-09	2.59
0.6158	8179.3	0.0019	2.81	192	0.5899	8179.3		2.72
0.6219	8372.3	0.0013	2.83	192	0.5944	8372.3	2.87E-08	2.74
0.6279	9481.1	0.0058	2.96	192	0.6001	9481.1	9.22E-08	2.78
0.6340	9565.5	0.0716	2.88	192	0.6089	9565.5	8.93E-08	2.78
0.6401	9617.1	0.1188	2.90	192	0.6119	9617.1	1.15E-07	2.80
0.6461	9656.5	0.1523	2.92	192	0.6178	9656.5	1.48E-07	2.82
0.6522	9701.6	0.1332	2.95	192	0.6238	9701.6	1.32E-07	2.84
0.6584	9748.9	0.1375	2.97	192	0.6299	9748.9	1.35E-07	2.87
0.6644	9807.8	0.0991	2.99	192	0.6357	9807.8	9.56E-08	2.89
0.6704	9859.5	0.1189	3.02	192	0.6415	9859.5	1.13E-07	2.91
0.6764	9905.8	0.1301	3.04	192	0.6474	9905.8	1.27E-07	2.93
0.6824	9930.2	0.2446	3.06	192	0.6533	9930.2	2.41E-07	2.95
0.6885	9940.4	0.5654	3.09	192	0.6594	9940.4	5.95E-07	2.99
0.6946	9971.7	0.1916	3.11	192	0.6654	9971.7	1.92E-07	3.00
0.7006	10028.2	0.1070	3.14	192	0.6712	10028.2	1.03E-07	3.02
0.7066	10078.7	0.1194	3.16	192	0.6771	10078.7	1.16E-07	3.05
0.7127	10127.8	0.1248	3.27	197	0.6830	10127.8	1.22E-07	3.15
0.7188	10156.9	0.2078	3.29	197	0.6891	10156.9	2.05E-07	3.17
0.7250	10182.1	0.2460	3.32	197	0.6952	10182.1	2.43E-07	3.20
0.7310	10217.5	0.1702	3.35	197	0.7011	10217.5	1.67E-07	3.22
0.7371	10244.4	0.2265	3.46	202	0.7071	10244.4	2.24E-07	3.33
0.7432	10268.5	0.2513	3.48	202	0.7131	10268.5	2.50E-07	3.36
0.7492	10298.5	0.2148	3.51	202	0.7190	10298.5	2.11E-07	3.38
0.7552	10317.4	0.2884	3.54	202	0.7250	10317.4	2.84E-07	3.41
0.7613	10338.3	0.2772	3.57	202	0.7310	10338.3	2.76E-07	3.43
0.7673	10369.0	0.2020	3.68	207	0.7368	10369.0	1.99E-07	3.55
0.7735	10398.7	0.2224	3.71	207	0.7430	10398.7	2.21E-07	3.57
0.7795	0.0	0.0000	3.84	212	0.7480	10429.0	1.70E-07	3.66
0.7868	38.0	0.2630	3.87	212	0.7562	10465.0	2.81E-07	3.73
0.7969	87.7	0.3529	3.92	212	0.7662	10493.7	3.49E-07	3.78
0.8089	106.7	0.2573	3.96	212	0.7761	10532.7	2.53E-07	3.83
0.8191	153.8	0.2161	4.03	212	0.7862	10579.8	2.14E-07	3.88
0.8291	188.0	0.3114	4.08	212	0.7961	10612.0	3.08E-07	3.93
0.8391	225.7	0.2521	4.14	212	0.8060	10651.7	2.49E-07	3.99
0.8492	267.4	0.2408	4.35	220	0.8160	10693.4	2.38E-07	4.19
0.8592	300.2	0.3082	4.41	220	0.8279	10729.2	3.02E-07	4.25
0.8692	318.9	0.5309	4.47	220	0.8378	10745.9	5.29E-07	4.30
0.8793	347.1	0.3561	4.54	220	0.8478	10773.1	3.57E-07	4.36
0.8893	381.2	0.2940	4.60	220	0.8577	10807.2	2.90E-07	4.42
0.8995	403.8	0.4545	4.67	220	0.8680	10829.8	4.53E-07	4.48
0.9097	422.2	0.5488	4.73	220	0.8780	10848.2	5.48E-07	4.55
0.9198	453.8	0.3229	4.80	220	0.8881	10879.8	3.20E-07	4.61
0.9298	485.2	0.3186	4.87	220	0.8980	10911.2	3.16E-07	4.68
0.9402	500.0	0.6838	4.94	220	0.9083	10926.0	6.83E-07	4.74
0.9502	524.5	0.4118	5.02	220	0.9182	10950.5	4.05E-07	4.81
0.9603	548.9	0.4135	5.09	220	0.9282	10974.8	4.11E-07	4.88
0.9705	558.7	1.0400	5.17	220	0.9384	10984.7	1.04E-06	4.95
0.9807	576.9	0.5588	5.25	220	0.9486	11002.9	5.58E-07	5.03
0.9907	605.1	0.3650	5.33	220	0.9585	11029.1	3.79E-07	5.10
1.0010	621.4	0.6615	5.41	220	0.9687	11047.4	6.60E-07	5.18
1.0114	629.6	1.2581	5.50	220	0.9791	11055.6	1.27E-06	5.26
1.0214	653.4	0.4210	5.58	220	0.9890	11079.4	4.17E-07	5.34
1.0314	673.9	0.4993	5.66	220	0.9990	11099.9	4.95E-07	5.42
1.0419	686.0	0.8182	5.77	220	1.0091	11112.0	8.13E-07	5.51
1.0518	698.9	0.7281	5.86	220	1.0193	11125.9	7.31E-07	5.60
1.0619	716.8	0.8004	5.96	220	1.0294	11142.8	8.06E-07	5.69
1.0723	726.2	0.9062	6.06	220	1.0397	11184.2	9.09E-07	5.78
1.0824	738.5	1.2296	6.17	220	1.0499	11162.5	1.21E-06	5.88
1.0925	747.0	0.8547	6.27	220	1.0599	11173.0	8.56E-07	5.97
1.1026	760.0	0.9158	6.38	220	1.0699	11184.0	9.15E-07	6.07
1.1129	765.2	1.4465	6.48	220	1.0802	11191.2	1.43E-06	6.18
1.1229	774.8	1.0929	6.61	220	1.0902	11200.8	1.10E-06	6.28
1.1331	781.0	1.5258	6.73	220	1.1004	11207.0	1.52E-06	6.38
1.1437	788.4	1.9463	6.86	220	1.1108	11212.4	1.88E-06	6.51
1.1544	790.3	2.7488	6.96	220	1.1210	11216.3	2.74E-06	6.64
1.1645	795.9	1.8064	7.12	220	1.1317	11221.9	1.80E-06	6.76
1.1746	800.1	2.4188	7.26	220	1.1417	11226.1	2.39E-06	6.88
1.1849	803.1	3.3709	7.40	220	1.1518	11229.1	3.36E-06	7.01
1.1951	807.8	2.3584	7.55	220	1.1625	11233.8	2.37E-06	7.15
1.2053	811.0	2.9764	7.70	220	1.1725	11237.0	2.94E-06	7.28
1.2154	814.1	3.2819	7.86	220	1.1828	11240.1	3.26E-06	7.42
1.2255	816.9	3.0290	8.02	220	1.1937	11242.9	3.00E-06	7.58
1.2365	820.1	3.1308	8.20	220	1.2038	11246.1	3.12E-06	7.73
1.2473	823.2	3.5332	8.38	220	1.2144	11249.2	3.48E-06	7.90
1.2576	825.2	5.0071	8.56	220	1.2247	11251.2	5.15E-06	8.07
1.2678	828.3	3.3038	8.75	220	1.2347	11254.3	3.22E-06	8.23
1.2783	831.1	4.0853	8.96	220	1.2454	11257.1	4.18E-06	8.43
1.2887	833.2	5.1640	9.16	220	1.2568	11258.2	4.95E-06	8.62
1.2988	835.5	4.3811	9.36	220	1.2670	11261.5	4.43E-06	8.81
1.3101	837.8	4.5158	9.61	220	1.2772	11263.8	4.40E-06	9.01
1.3210	839.6	5.3814	9.85	220	1.2881	11265.6	5.45E-06	9.23
1.3312	841.4	6.3832	10.09	220	1.2983	11267.4	6.37E-06	9.44
1.3418	843.7	4.4819	10.34	220	1.3087	11269.7	4.52E-06	9.67
1.3555	846.0	9.1327	10.65	220	1.3226	11272.0	9.04E-06	9.96
1.3656	847.7	9.8807	10.97	220	1.3327	11273.7	9.84E-06	10.23
1.3757	849.7	4.9864	11.25	220	1.3428	11275.7	5.05E-06	10.48
1.3866	852.0	6.1713	11.61	220	1.3538	11278.0	6.13E-06	10.85
1.4002	853.3	7.6461	11.98	220	1.3675	11279.3	8.00E-06	11.13
1.4153	855.4	8.1981	12.37	220	1.3809	11281.4	8.24E-06	11.51
1.4268	857.6	8.7429	12.82	220	1.3938	11283.6	9.62E-06	11.92
1.4377	859.3	7.1429	13.27	220	1.4047	11285.3	7.20E-06	12.27
1.4487	861.0	9.3788	13.69	220	1.4157	11287.0	9.47E-06	12.64
1.4587	862.7	9.8646	14.11	220	1.4257	11288.7	9.86E-06	13.00
1.4700	864.3	8.9838	14.58	220	1.4370	11290.3	7.08E-06	13.42
1.4817	865.8	7.9354	15.09	220	1.4487	11291.8	7.80E-06	13.89
1.4941	867.8	8.7107	15.65	220	1.4611	11293.8	8.66E-06	14.39
1.5076	869.0	8.9736	16.31	220	1.4746	11295.0	9.04E-06	14.99
1.5177	870.3	7.5857	16.96	220	1.4847	11296.3	7.77E-06	15.46

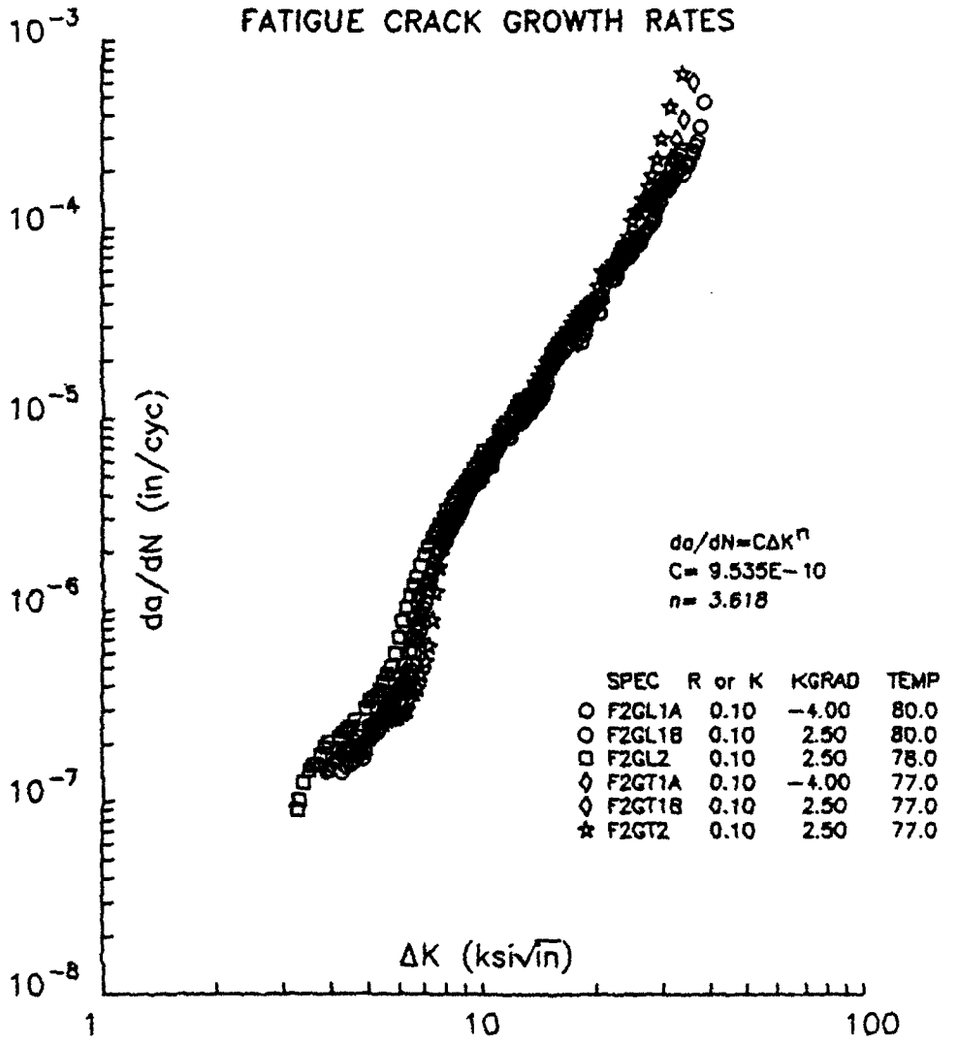


Figure 18. Fatigue Crack Growth Rate Data for 2095-T8 0.5 Inch Thick Plate (L-T and T-L orientations). Northrop.

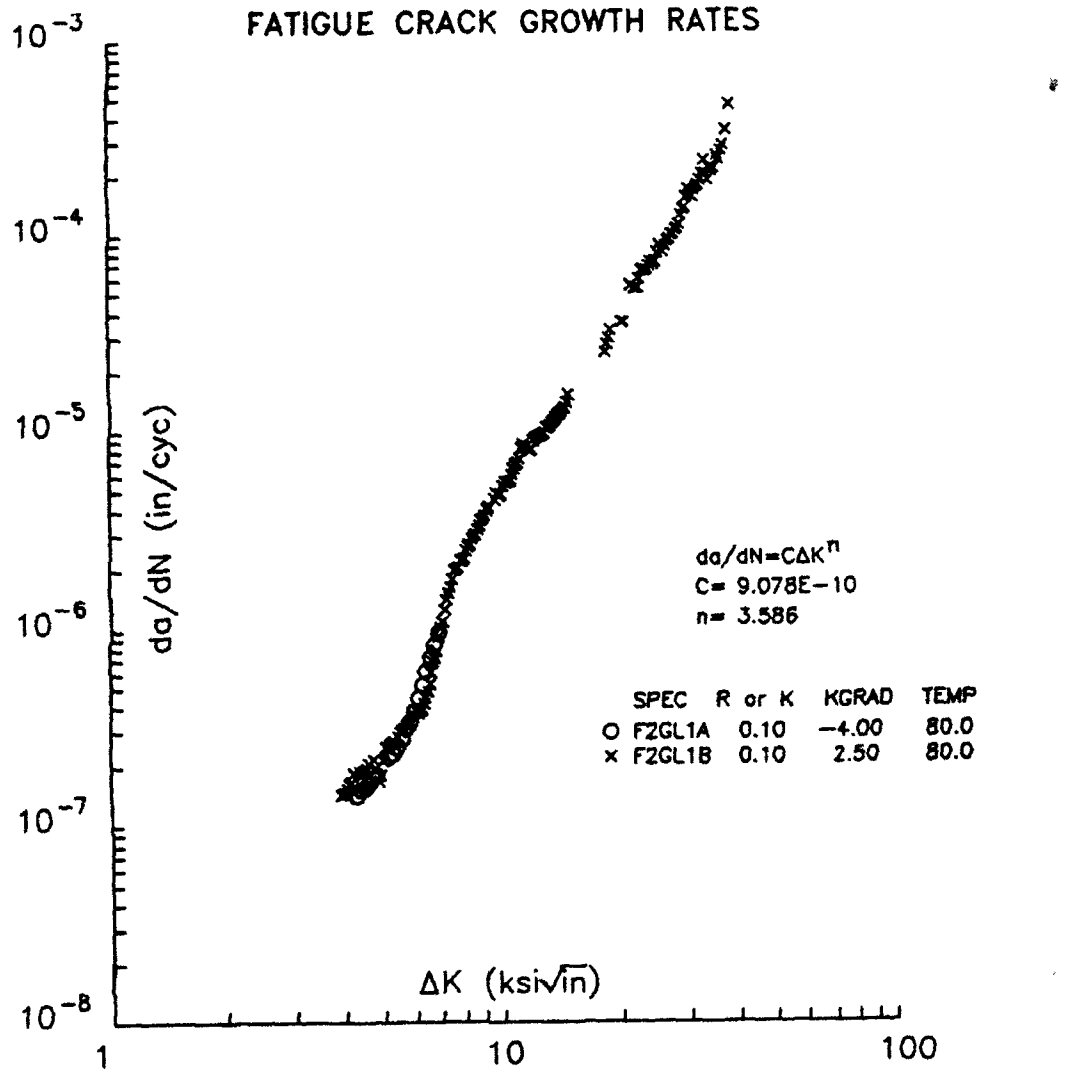


Figure I9. Fatigue Crack Growth Rate Data for 2095-T8 0.5 Inch Thick Plate (L-T orientation, KGRAD - 4.00 and 2.50). Northrop.

TABLE I31

Fatigue Crack Growth Data Associated with Figure I9 (Specimen F2GL1A)

AUTOMATED FATIGUE CRACK GROWTH RATE ANALYSIS

Specimen Id.	F2GL1A	Geometry	C(T)
Contract #	WB02115N	Orientation	L-T
Material	Weldalite	Yield (ksi)	82.0
Temperature (F)	80	Modulus	11.1
Environment	Lab. air		

Specimen Dimensions (in)

Thickness	0.495	Notch depth	0.609
Width	2.997	Gage length	1.000
Height	3.600	Alpha ratio	1.250

Precrack Parameters

Pmax (lbs)	1471.0	Stress ratio (R)	0.10
Final a (in)	0.689	Kmax	8.00

Test Parameters

Initial a (in)	0.689	Initial K	8.00
K-gradient	-4.00	Stress ratio (R)	0.10

K Coeff	EvB/P Coeff
0.886000	1.000980
4.640000	-4.669510
-13.320000	18.460100
14.720000	-236.824997
-5.600000	1214.880000
0.000000	-2143.570100

Analysis Codes

KRP 2 0

Visual Observations

EvB/P	Crack (EvB/P)	Crack (visual)	Error	CAF
19.54	0.689	0.656	-.033	1.000
20.82	0.745	0.715	-.031	1.000
21.33	0.766	0.728	-.038	1.000
21.58	0.776	0.754	-.023	1.000
21.67	0.780	0.757	-.023	1.000
23.00	0.831	0.800	-.031	1.000
23.65	0.855	0.818	-.036	1.000
24.14	0.872	0.836	-.036	1.000
25.06	0.904	0.870	-.034	1.000
27.11	0.969	0.928	-.041	1.000
29.75	1.045	1.017	-.028	1.000
92.36	1.818	1.818	-.000	1.000

Pmax (lbs)	E4B/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksi√in)
	19.64	0.6938	4398				
1393	19.80	0.7011	11308	0.0130	13262	9.783E-07	6.89
1347	19.93	0.7067	17660	0.0118	14041	8.406E-07	6.70
1308	20.07	0.7129	25349	0.0125	17258	7.251E-07	6.55
1269	20.22	0.7193	34918	0.0126	20541	6.157E-07	6.38
1232	20.36	0.7255	45890	0.0120	22772	5.256E-07	6.23
1195	20.49	0.7312	57689	0.0117	26035	4.505E-07	6.08
1162	20.63	0.7373	71925	0.0118	30699	3.849E-07	5.94
1128	20.77	0.7430	88368	0.0118	34418	3.416E-07	5.80
1095	20.91	0.7490	106343	0.0124	39201	3.158E-07	5.66
1063	21.07	0.7554	127588	0.0123	44693	2.761E-07	5.53
1031	21.21	0.7614	151035	0.0120	48064	2.496E-07	5.39
1001	21.36	0.7674	175652	0.0121	51794	2.336E-07	5.27
974	21.51	0.7735	202829	0.0111	49535	2.245E-07	5.15
	21.64	0.7785	225187				
	21.82	0.7859	249807				
888	21.97	0.7918	282411	0.0119	66418	1.796E-07	4.77
863	22.13	0.7978	316225	0.0121	69261	1.745E-07	4.66
838	22.28	0.8038	351672	0.0118	71831	1.638E-07	4.55
814	22.43	0.8096	388056	0.0116	73904	1.574E-07	4.45
791	22.59	0.8155	425576	0.0120	78849	1.523E-07	4.34
768	22.75	0.8216	466905	0.0122	85698	1.428E-07	4.24
	22.91	0.8277	511274				
	23.08	0.8341	537843				
	23.23	0.8395	565306				

TABLE I32

Fatigue Crack Growth Data Associated with Figure I9 (Specimen F2GL1B)

AUTOMATED FATIGUE CRACK GROWTH RATE ANALYSIS

Specimen Id.	F2GL1B	Geometry	C(T)
Contract #	WB02115N	Orientation	L-T
Material	Weldalite	Yield (ksi)	82.0
Temperature (F)	80	Modulus	11.1
Environment	Lab. air		

Specimen Dimensions (in)

Thickness	0.495	Notch depth	0.609
Width	2.997	Gage length	1.000
Height	3.600	Alpha ratio	1.250

Precrack Parameters

Pmax (lbs)	1471.0	Stress ratio (R)	0.10
Final a (in)	0.689	Kmax	8.00

Test Parameters

Initial a (in)	0.655	Initial K	4.10
K-gradient	2.50	Stress ratio (R)	0.10

K Coeff	EvB/P Coeff
0.886000	1.000980
4.640000	-4.669510
-13.320000	18.460100
14.720000	-236.824997
-5.600000	1214.880000
0.000000	-2143.570100

Analysis Codes

KRP 2 0

Visual Observations

EvB/P	Crack (EvB/P)	Crack (visual)	Error	CAF
19.54	0.689	0.656	-.033	1.000
20.82	0.745	0.715	-.031	1.000
21.33	0.766	0.728	-.038	1.000
21.58	0.776	0.754	-.023	1.000
21.67	0.780	0.757	-.023	1.000
23.00	0.831	0.800	-.031	1.000
23.65	0.855	0.818	-.036	1.000
24.14	0.872	0.836	-.036	1.000
25.06	0.904	0.870	-.034	1.000
27.11	0.969	0.928	-.041	1.000
29.75	1.045	1.017	-.028	1.000
92.36	1.818	1.818	-.000	1.000

Comments

Date of test: 08-12-1992

TABLE I32 (Continued)

Specimen Id. F2GL1B — Page 1

Pmax (lbs)	E4B/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksi√in)
	24.01	0.8676	106831				
669	24.17	0.8732	146247	0.0106	73428	1.449E-07	3.86
674	24.32	0.8782	180259	0.0093	63733	1.457E-07	3.91
680	24.44	0.8825	209981	0.0089	60742	1.472E-07	3.96
685	24.58	0.8872	241001	0.0095	61687	1.543E-07	4.00
690	24.72	0.8920	271668	0.0095	58702	1.614E-07	4.05
695	24.86	0.8966	299703	0.0092	55018	1.665E-07	4.10
700	24.99	0.9012	326686	0.0076	41150	1.843E-07	4.14
	25.08	0.9042	340853				
	25.27	0.9106	351337				
716	25.40	0.9147	372211	0.0086	45977	1.878E-07	4.29
722	25.54	0.9192	397314	0.0092	50824	1.802E-07	4.34
727	25.68	0.9239	423034	0.0091	48344	1.887E-07	4.38
732	25.82	0.9283	445658	0.0085	44229	1.913E-07	4.43
738	25.94	0.9323	467264	0.0090	45789	1.962E-07	4.48
743	26.10	0.9373	491447	0.0098	47368	2.060E-07	4.53
	26.25	0.9421	514632				
	26.37	0.9460	541121				
760	26.54	0.9513	567212	0.0092	42714	2.164E-07	4.69
765	26.67	0.9552	583835	0.0073	36982	1.962E-07	4.74
773	26.78	0.9585	604194	0.0119	69783	1.699E-07	4.81
779	27.06	0.9671	653618	0.0153	84036	1.815E-07	4.87
788	27.28	0.9738	688230	0.0112	52470	2.140E-07	4.95
795	27.43	0.9783	706088	0.0088	35600	2.482E-07	5.02
801	27.57	0.9826	723831	0.0089	35807	2.494E-07	5.08
807	27.73	0.9872	741895	0.0090	35028	2.572E-07	5.14
813	27.88	0.9916	758859	0.0089	33811	2.630E-07	5.20
819	28.03	0.9961	775705	0.0091	33723	2.705E-07	5.25
	28.19	1.0007	792582				
	28.34	1.0049	808585				
837	28.49	1.0093	824320	0.0089	31332	2.841E-07	5.43
843	28.65	1.0138	839917	0.0094	31185	3.000E-07	5.49
849	28.82	1.0187	855505	0.0094	30476	3.071E-07	5.56
856	28.98	1.0232	870392	0.0089	28439	3.121E-07	5.62
862	29.14	1.0275	883944	0.0088	27058	3.258E-07	5.68
868	29.30	1.0320	897450	0.0090	27034	3.323E-07	5.75
875	29.46	1.0365	910978	0.0089	27019	3.304E-07	5.81
881	29.62	1.0409	924470	0.0087	23027	3.759E-07	5.88
	29.78	1.0452	934006				
	29.99	1.0509	940920				
902	30.12	1.0542	950546	0.0079	21063	3.731E-07	6.09
907	30.29	1.0588	961982	0.0090	23286	3.864E-07	6.14
914	30.46	1.0632	973833	0.0091	23266	3.910E-07	6.22
921	30.63	1.0679	985248	0.0090	21506	4.191E-07	6.28
928	30.80	1.0723	995339	0.0089	19742	4.499E-07	6.36

Specimen Id. F2GL1B — Page 2

Pmax (lbs)	E4B/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksi√in)
935	30.98	1.0768	1004990	0.0091	18862	4.840E-07	6.43
942	31.16	1.0814	1014201	0.0093	17546	5.297E-07	6.50
949	31.34	1.0861	1022536	0.0095	15479	6.108E-07	6.58
956	31.53	1.0908	1029679	0.0091	13151	6.907E-07	6.65
963	31.70	1.0952	1035686	0.0087	11912	7.275E-07	6.73
970	31.87	1.0995	1041591	0.0089	11248	7.897E-07	6.80
977	32.06	1.1040	1046934	0.0091	9853	9.256E-07	6.88
985	32.24	1.1086	1051444	0.0091	8856	1.029E-06	6.96
992	32.43	1.1132	1055790	0.0088	7892	1.109E-06	7.04
999	32.60	1.1174	1059335	0.0088	6876	1.276E-06	7.12
1007	32.79	1.1219	1062665	0.0093	6517	1.427E-06	7.20
1014	32.99	1.1267	1065853	0.0089	5795	1.533E-06	7.28
1021	33.16	1.1308	1068460	0.0086	5212	1.642E-06	7.36
1029	33.35	1.1352	1071065	0.0092	5087	1.812E-06	7.44
1036	33.56	1.1400	1073547	0.0091	4562	1.995E-06	7.52
1044	33.74	1.1443	1075626	0.0088	4357	2.028E-06	7.61
1052	33.94	1.1489	1077904	0.0095	4588	2.063E-06	7.70
1060	34.15	1.1538	1080215	0.0095	4233	2.235E-06	7.79
1068	34.35	1.1583	1082137	0.0087	3878	2.236E-06	7.88
1076	34.54	1.1625	1084093	0.0089	3869	2.308E-06	7.97
1083	34.75	1.1673	1086006	0.0089	3508	2.528E-06	8.05
1091	34.93	1.1713	1087601	0.0085	3236	2.634E-06	8.15
1099	35.13	1.1758	1089242	0.0087	3215	2.706E-06	8.23
1107	35.33	1.1800	1090816	0.0087	3011	2.903E-06	8.32
1114	35.53	1.1845	1092252	0.0087	2899	3.019E-06	8.41
1123	35.73	1.1888	1093714	0.0091	2993	3.052E-06	8.51
1131	35.96	1.1937	1095245	0.0094	2899	3.239E-06	8.61
1139	36.17	1.1982	1096613	0.0088	2599	3.394E-06	8.70
1147	36.37	1.2025	1097844	0.0088	2477	3.562E-06	8.80
1156	36.59	1.2070	1099091	0.0093	2542	3.677E-06	8.90
1164	36.82	1.2118	1100387	0.0092	2442	3.777E-06	9.00
1173	37.03	1.2162	1101533	0.0089	2193	4.079E-06	9.11
1181	37.25	1.2208	1102580	0.0089	2094	4.234E-06	9.21
	37.47	1.2251	1103627				
	37.69	1.2297	1104724				
1208	37.91	1.2341	1105772	0.0094	2046	4.583E-06	9.53
1216	38.16	1.2390	1106770	0.0093	1898	4.924E-06	9.64
1225	38.38	1.2434	1107670	0.0086	1799	4.786E-06	9.75
1234	38.60	1.2476	1108559	0.0086	1743	4.905E-06	9.85
1242	38.82	1.2520	1109414	0.0088	1628	5.395E-06	9.96
1251	39.05	1.2564	1110187	0.0090	1587	5.644E-06	10.07
1261	39.29	1.2609	1111001	0.0093	1667	5.560E-06	10.19
1270	39.53	1.2657	1111855	0.0094	1668	5.639E-06	10.31
1279	39.78	1.2703	1112669	0.0087	1527	5.731E-06	10.42
1288	40.00	1.2744	1113381	0.0086	1404	6.100E-06	10.54
1297	40.24	1.2789	1114072	0.0091	1383	6.545E-06	10.65
1307	40.49	1.2835	1114764	0.0093	1353	6.884E-06	10.78
1316	40.75	1.2882	1115426	0.0092	1308	7.057E-06	10.90
1326	40.99	1.2927	1116072	0.0089	1314	7.325E-06	11.03

TABLE I32 (Continued)

Specimen Id. F2GL1B — Page 3

Pmax (lbs)	E4B/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksi√in)
1335	41.24	1.2971	1116639	0.0088	1062	8.264E-06	11.15
1344	41.48	1.3015	1117134	0.0088	1016	8.630E-06	11.27
1354	41.73	1.3059	1117655	0.0096	1146	8.337E-06	11.41
1364	42.02	1.3110	1118280	0.0097	1147	8.426E-06	11.54
1373	42.28	1.3155	1118802	0.0080	985	8.106E-06	11.66
1383	42.48	1.3190	1119265	0.0081	995	8.150E-06	11.79
1392	42.75	1.3236	1119797	0.0094	1041	9.059E-06	11.92
1402	43.03	1.3284	1120306	0.0091	997	9.147E-06	12.05
1412	43.29	1.3328	1120794	0.0088	932	9.416E-06	12.19
1422	43.55	1.3372	1121238	0.0085	887	9.553E-06	12.32
1432	43.79	1.3412	1121681	0.0091	951	9.580E-06	12.47
1442	44.10	1.3463	1122189	0.0095	974	9.768E-06	12.60
1453	44.37	1.3507	1122655	0.0092	921	9.992E-06	12.76
1463	44.67	1.3555	1123110	0.0093	888	1.052E-05	12.90
1473	44.95	1.3601	1123543	0.0085	804	1.051E-05	13.04
1484	45.19	1.3640	1123914	0.0086	794	1.085E-05	13.19
1494	45.49	1.3687	1124337	0.0095	853	1.116E-05	13.34
1504	45.79	1.3735	1124767	0.0088	772	1.141E-05	13.48
1514	46.05	1.3775	1125109	0.0082	689	1.186E-05	13.63
1525	46.32	1.3817	1125456	0.0095	774	1.233E-05	13.80
1536	46.67	1.3871	1125883	0.0100	805	1.243E-05	13.95
1547	46.97	1.3917	1126261	0.0090	702	1.276E-05	14.12
1558	47.26	1.3960	1126585	0.0085	646	1.320E-05	14.27
1568	47.54	1.4002	1126907	0.0084	631	1.331E-05	14.43
1579	47.83	1.4044	1127216	0.0088	619	1.421E-05	14.59
1590	48.14	1.4090	1127526	0.0094	606	1.558E-05	14.75
	48.47	1.4139	1127823				
	54.16	1.4905	1139102				
1808	54.57	1.4956	1139298	0.0088	342	2.569E-05	18.28
1822	54.86	1.4993	1139445	0.0085	305	2.796E-05	18.51
1833	55.26	1.5041	1139603	0.0096	318	3.010E-05	18.71
1846	55.65	1.5089	1139762	0.0093	279	3.318E-05	18.93
	56.03	1.5134	1139883				
	56.42	1.5180	1139993				
1915	56.87	1.5234	1140101	0.0314	862	3.644E-05	20.15
1928	59.16	1.5494	1140854	0.0302	834	3.619E-05	20.39
1971	59.53	1.5536	1140935	0.0096	173	5.574E-05	21.21
1983	60.04	1.5591	1141027	0.0093	166	5.623E-05	21.42
2000	60.39	1.5629	1141101	0.0104	192	5.400E-05	21.74
2011	61.00	1.5695	1141220	0.0106	193	5.469E-05	21.96
2024	61.38	1.5735	1141294	0.0067	123	5.455E-05	22.21
2036	61.64	1.5762	1141343	0.0074	122	6.028E-05	22.45
2048	62.08	1.5808	1141416	0.0097	147	6.621E-05	22.68
2060	62.57	1.5859	1141490	0.0091	134	6.817E-05	22.92
2074	62.97	1.5900	1141550	0.0085	128	6.632E-05	23.20
2087	63.41	1.5944	1141618	0.0090	134	6.704E-05	23.45
2100	63.86	1.5990	1141685	0.0090	128	7.016E-05	23.71
2113	64.31	1.6034	1141746	0.0090	122	7.355E-05	23.98

Specimen Id. F2GL1B — Page 4

Pmax (lbs)	E4B/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksi√in)
2126	64.77	1.6080	1141807	0.0087	122	7.129E-05	24.24
2140	65.20	1.6121	1141868	0.0089	122	7.340E-05	24.53
2151	65.69	1.6169	1141928	0.0086	115	7.418E-05	24.77
2166	66.09	1.6206	1141983	0.0090	109	8.211E-05	25.08
2179	66.64	1.6259	1142038	0.0099	109	9.042E-05	25.35
2193	67.13	1.6305	1142092	0.0092	109	8.442E-05	25.66
2207	67.62	1.6351	1142147	0.0091	109	8.327E-05	25.95
2221	68.12	1.6396	1142201	0.0092	103	8.923E-05	26.25
2235	68.63	1.6442	1142250	0.0091	97	9.442E-05	26.55
2249	69.13	1.6487	1142298	0.0093	97	9.656E-05	26.87
2262	69.67	1.6536	1142346	0.0091	90	1.006E-04	27.16
2276	70.15	1.6578	1142388	0.0085	84	1.017E-04	27.47
2290	70.65	1.6621	1142430	0.0090	84	1.070E-04	27.78
2303	71.19	1.6668	1142472	0.0092	84	1.092E-04	28.09
2318	71.71	1.6713	1142514	0.0097	84	1.153E-04	28.44
2332	72.33	1.6764	1142556	0.0098	77	1.271E-04	28.76
2347	72.88	1.6811	1142591	0.0089	65	1.365E-04	29.10
2360	73.39	1.6853	1142621	0.0082	59	1.398E-04	29.42
2375	73.89	1.6893	1142650	0.0093	58	1.594E-04	29.77
2389	74.54	1.6946	1142679	0.0102	59	1.746E-04	30.11
2405	75.16	1.6996	1142709	0.0096	59	1.622E-04	30.48
2420	75.74	1.7042	1142738	0.0093	59	1.594E-04	30.85
2434	76.35	1.7089	1142767	0.0089	52	1.730E-04	31.19
2447	76.89	1.7131	1142790	0.0082	46	1.776E-04	31.54
2461	77.42	1.7171	1142814	0.0085	47	1.831E-04	31.88
2475	78.00	1.7216	1142836	0.0095	49	1.932E-04	32.25
2492	78.68	1.7267	1142863	0.0107	52	2.086E-04	32.66
2508	79.45	1.7323	1142888	0.0110	45	2.453E-04	33.09
2522	80.18	1.7377	1142908	0.0086	41	2.088E-04	33.45
2537	80.62	1.7409	1142929	0.0073	38	1.942E-04	33.85
2551	81.19	1.7450	1142946	0.0096	44	2.204E-04	34.22
2568	81.97	1.7505	1142972	0.0118	55	2.146E-04	34.67
2582	82.88	1.7568	1143001	0.0100	45	2.228E-04	35.07
2602	83.42	1.7605	1143017	0.0094	37	2.582E-04	35.60
2614	84.25	1.7662	1143037	0.0099	40	2.476E-04	35.96
2635	84.88	1.7704	1143057	0.0110	40	2.743E-04	36.52
2649	85.90	1.7772	1143077	0.0116	40	2.905E-04	36.94
2675	86.64	1.7820	1143097	0.0139	40	3.485E-04	37.68
2702	88.06	1.7911	1143117	0.0209	45	4.708E-04	38.48
	89.96	1.8030	1143142				

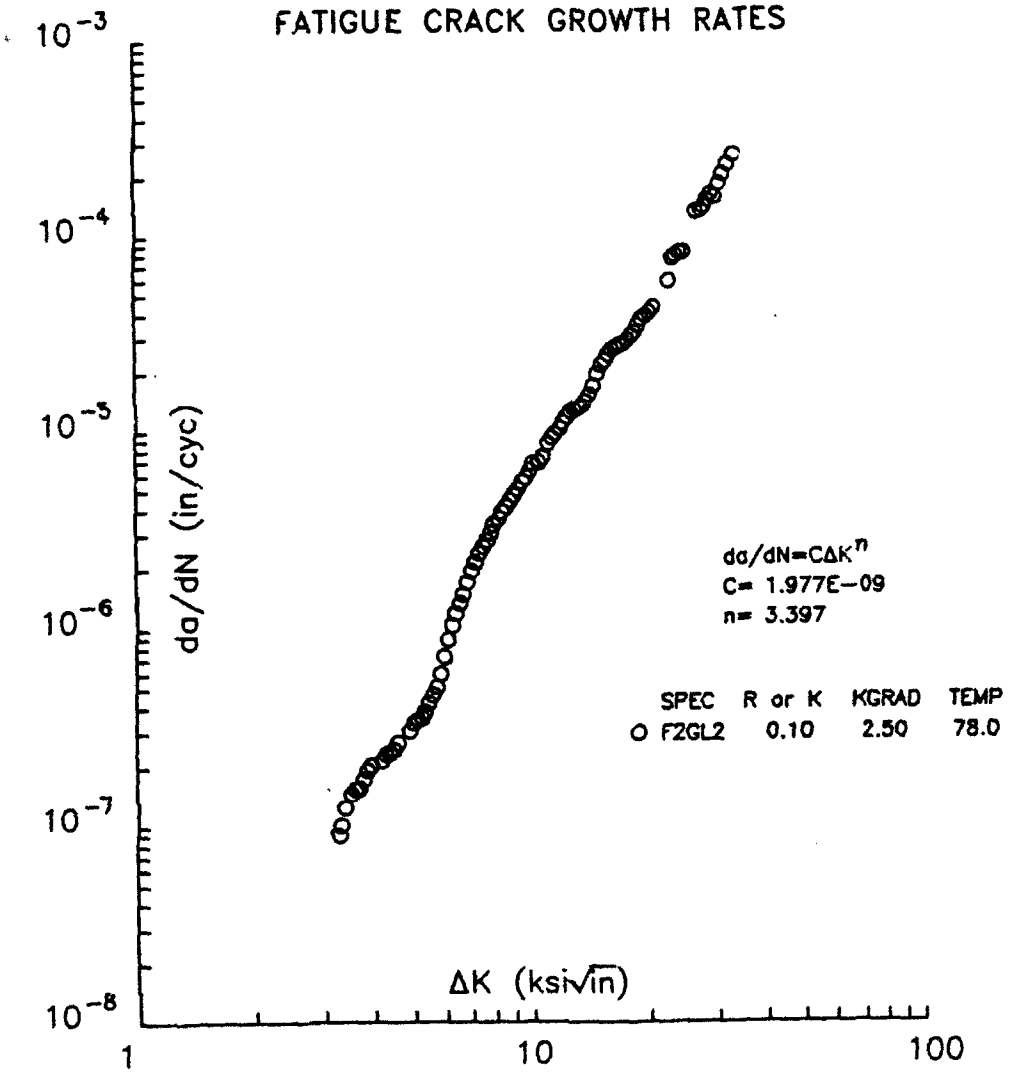


Figure I10. Fatigue Crack Growth Rate Data for 2095-T8 0.5 Inch Thick Plate (L-T orientation, KGRAD 2.50). Northrop.

TABLE I33

Fatigue Crack Growth Data Associated with Figure I10 (Specimen F2GL2)

AUTOMATED FATIGUE CRACK GROWTH RATE ANALYSIS

Specimen Id.	F2GL2	Geometry	C(T)
Contract #	WB02115.1	Orientation	L-T
Material	WELDALITE	Yield (ksi)	101.0
Temperature (F)	78	Modulus	10.6
Environment	Lab. air		

Specimen Dimensions (in)

Thickness	0.495	Notch depth	0.605
Width	2.996	Gage length	1.000
Height	3.600	Alpha ratio	1.250

Precrack Parameters

Pmax (lbs)	911.0	Stress ratio (R)	0.10
Final a (in)	0.680	Kmax	4.91

Test Parameters

Initial a (in)	0.771	Initial K	3.40
K-gradient	2.50	Stress ratio (R)	0.10

K Coeff	EvB/P Coeff
0.886000	1.000980
4.640000	-4.669510
-13.320000	18.460100
14.720000	-236.824997
-5.600000	1214.880000
0.000000	-2143.570100

Analysis Codes
KRP 1 0

Visual Observations

EvB/P	Crack (EvB/P)	Crack (visual)	Error	CAF
24.03	0.855	0.849	-.006	0.985
25.57	0.909	0.910	0.002	0.986
27.48	0.970	0.972	0.002	0.988
30.72	1.063	1.069	0.007	0.991
32.46	1.108	1.110	0.002	0.993
34.22	1.150	1.150	-.000	0.994
36.98	1.211	1.206	-.006	0.996

Comments

Date of test: 01-28-1992

TABLE I33 (Continued)

Specimen Id. F2GL2 — Page 1

Pmax (lbs)	E4B/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksi√in)
	21.89	0.7752	174177				
605	22.12	0.7841	271818	0.0181	199081	9.074E-08	3.23
614	22.35	0.7933	373258	0.0185	181574	1.019E-07	3.31
623	22.60	0.8027	453392	0.0186	147514	1.258E-07	3.38
632	22.84	0.8118	520772	0.0181	123971	1.457E-07	3.46
642	23.08	0.8207	577362	0.0178	115839	1.538E-07	3.54
651	23.32	0.8296	636611	0.0184	117511	1.566E-07	3.62
661	23.58	0.8391	694873	0.0185	106408	1.736E-07	3.70
671	23.83	0.8481	743019	0.0182	93930	1.936E-07	3.79
681	24.09	0.8573	788803	0.0183	89828	2.043E-07	3.88
	24.35	0.8665	832847				
	24.60	0.8752	882227				
711	24.88	0.8853	930654	0.0196	90775	2.163E-07	4.15
723	25.16	0.8949	973001	0.0191	82526	2.320E-07	4.25
733	25.44	0.9044	1013179	0.0185	77921	2.371E-07	4.35
744	25.71	0.9133	1050922	0.0180	73302	2.455E-07	4.45
755	25.98	0.9224	1086482	0.0185	69438	2.663E-07	4.55
	26.27	0.9318	1120360				
	26.51	0.9395	1163004				
789	26.87	0.9509	1202178	0.0204	66424	3.074E-07	4.86
801	27.15	0.9599	1229428	0.0179	53217	3.365E-07	4.99
813	27.44	0.9688	1255395	0.0180	51412	3.502E-07	5.10
825	27.74	0.9779	1280840	0.0182	50526	3.594E-07	5.21
837	28.04	0.9870	1305921	0.0184	48354	3.814E-07	5.33
850	28.35	0.9963	1329194	0.0191	44973	4.255E-07	5.46
862	28.69	1.0061	1350893	0.0189	40277	4.684E-07	5.58
876	29.00	1.0152	1369471	0.0182	35243	5.150E-07	5.71
889	29.32	1.0243	1386136	0.0185	30944	5.991E-07	5.84
902	29.66	1.0337	1400416	0.0187	25697	7.272E-07	5.98
915	29.99	1.0430	1411834	0.0186	20987	8.866E-07	6.12
929	30.33	1.0523	1421403	0.0184	17678	1.041E-06	6.26
943	30.67	1.0614	1429512	0.0182	15152	1.202E-06	6.40
956	31.01	1.0705	1436555	0.0180	13339	1.351E-06	6.54
970	31.35	1.0794	1442851	0.0179	11978	1.496E-06	6.69
985	31.70	1.0885	1448534	0.0185	10675	1.729E-06	6.84
999	32.07	1.0979	1453526	0.0185	9476	1.955E-06	7.00
1014	32.43	1.1070	1458010	0.0187	8639	2.167E-06	7.16
1029	32.82	1.1166	1462165	0.0186	7711	2.412E-06	7.32
1044	33.19	1.1256	1465721	0.0181	6889	2.620E-06	7.49
1060	33.56	1.1346	1469055	0.0187	6648	2.813E-06	7.67
1076	33.97	1.1443	1472369	0.0191	6179	3.092E-06	7.84
1091	34.37	1.1537	1475234	0.0179	5286	3.379E-06	8.02
1108	34.74	1.1622	1477655	0.0181	4998	3.627E-06	8.21
1124	35.17	1.1719	1480232	0.0192	4909	3.916E-06	8.39
1140	35.59	1.1814	1482565	0.0183	4379	4.182E-06	8.59
1157	35.99	1.1902	1484611	0.0179	4021	4.450E-06	8.79
1174	36.41	1.1993	1486586	0.0183	3823	4.794E-06	8.98
1191	36.84	1.2085	1488434	0.0183	3550	5.157E-06	9.19
1208	37.28	1.2176	1490136	0.0181	3271	5.539E-06	9.40
1226	37.72	1.2266	1491705	0.0180	3067	5.870E-06	9.61
1244	38.17	1.2356	1493203	0.0185	2923	6.339E-06	9.84
1262	38.66	1.2452	1494628	0.0185	2683	6.881E-06	10.06
1291	39.12	1.2540	1495886	0.0272	3928	6.919E-06	10.42

Specimen Id. F2GL2 — Page 2

Pmax (lbs)	E4B/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksi√in)
1309	40.08	1.2723	1498556	0.0271	3696	7.333E-06	10.65
1337	40.56	1.2812	1499582	0.0172	1386	8.666E-06	11.01
1356	41.02	1.2895	1500542	0.0177	1906	9.275E-06	11.26
1375	41.54	1.2988	1501488	0.0181	1846	9.793E-06	11.50
1395	42.03	1.3076	1502388	0.0181	1761	1.030E-05	11.77
1415	42.57	1.3170	1503250	0.0186	1682	1.106E-05	12.04
1435	43.11	1.3262	1504070	0.0178	1499	1.190E-05	12.31
1455	43.62	1.3348	1504748	0.0169	1336	1.266E-05	12.59
1475	44.12	1.3431	1505406	0.0174	1348	1.288E-05	12.87
1496	44.68	1.3522	1506096	0.0188	1413	1.332E-05	13.16
1517	45.29	1.3619	1506819	0.0187	1384	1.351E-05	13.46
1539	45.85	1.3709	1507480	0.0179	1261	1.423E-05	13.78
1561	46.43	1.3799	1508080	0.0181	1168	1.553E-05	14.09
1583	47.03	1.3890	1508648	0.0179	1046	1.713E-05	14.41
1605	47.62	1.3978	1509125	0.0179	901	1.981E-05	14.74
1626	48.23	1.4069	1509550	0.0177	805	2.204E-05	15.07
1648	48.83	1.4156	1509930	0.0172	740	2.323E-05	15.40
1671	49.42	1.4240	1510289	0.0181	720	2.509E-05	15.76
1693	50.10	1.4336	1510651	0.0184	698	2.643E-05	16.10
1717	50.75	1.4425	1510987	0.0180	661	2.721E-05	16.48
1741	51.42	1.4516	1511312	0.0183	649	2.815E-05	16.86
1764	52.11	1.4608	1511636	0.0181	636	2.846E-05	17.24
1789	52.79	1.4697	1511947	0.0181	610	2.962E-05	17.64
1812	53.50	1.4788	1512246	0.0174	559	3.119E-05	18.02
1836	54.16	1.4871	1512506	0.0173	534	3.231E-05	18.43
1861	54.88	1.4961	1512780	0.0190	547	3.484E-05	18.86
1886	55.71	1.5062	1513053	0.0193	508	3.800E-05	19.29
1912	56.47	1.5154	1513287	0.0180	457	3.944E-05	19.75
1938	57.23	1.5242	1513510	0.0180	444	4.056E-05	20.21
1964	58.02	1.5334	1513732	0.0186	431	4.310E-05	20.68
	58.86	1.5428	1513941				
	60.45	1.5603	1514439				
2068	61.43	1.5707	1514642	0.0185	312	5.938E-05	22.62
2096	62.20	1.5789	1514751	0.0169	218	7.773E-05	23.17
2121	63.06	1.5876	1514860	0.0175	218	8.041E-05	23.66
2147	63.92	1.5963	1514969	0.0179	217	8.238E-05	24.20
2175	64.85	1.6055	1515077	0.0190	230	8.254E-05	24.77
	65.87	1.6153	1515199				
	66.92	1.6253	1515325				
2265	68.57	1.6405	1515438	0.0202	152	1.331E-04	26.66
2302	69.12	1.6455	1515477	0.0137	100	1.372E-04	27.47
2325	70.11	1.6543	1515538	0.0183	129	1.413E-04	27.97
2352	71.20	1.6638	1515606	0.0184	120	1.538E-04	28.60
2381	72.25	1.6727	1515658	0.0181	109	1.652E-04	29.27
2409	73.35	1.6818	1515716	0.0177	111	1.594E-04	29.92
2437	74.40	1.6904	1515769	0.0171	93	1.848E-04	30.58
2471	75.47	1.6990	1515809	0.0209	101	2.070E-04	31.39
2511	77.06	1.7113	1515870	0.0289	123	2.346E-04	32.40
2550	79.25	1.7278	1515932	0.0280	106	2.634E-04	33.38
	80.83	1.7393	1515976				
	82.87	1.7538	1516023				
	85.09	1.7689	1516111				

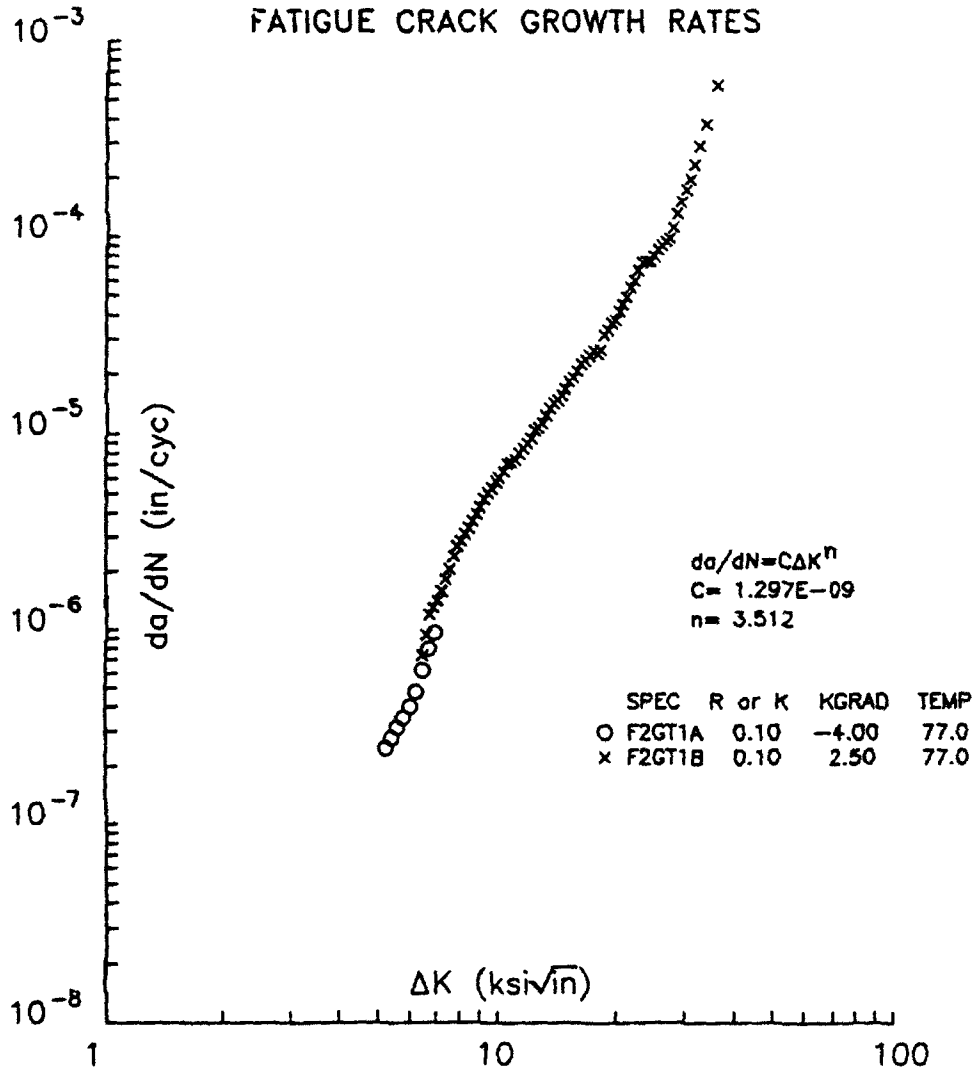


Figure I11. Fatigue Crack Growth Rate Data for 2095-T8 0.5 Inch Thick Plate (T-L orientation, KGRAD - 4.00 and 2.50). Northrop.

TABLE I34

Fatigue Crack Growth Data Associated with Figure I11 (Specimen F2GT1A)

AUTOMATED FATIGUE CRACK GROWTH RATE ANALYSIS

Specimen Id.	F2GT1A	Geometry	C(T)
Contract #	WB02115N	Orientation	T-L
Material	WELDALITE	Yield (ksi)	71.0
Temperature (F)	77	Modulus	10.9
Environment	Lab. air		

Specimen Dimensions (in)

Thickness	0.486	Notch depth	0.614
Width	2.997	Gage length	1.000
Height	3.600	Alpha ratio	1.250

Precrack Parameters

Pmax (lbs)	1271.0	Stress ratio (R)	0.10
Final a (in)	0.901	Kmax	8.50

Test Parameters

Initial a (in)	0.901	Initial K	8.50
K-gradient	-4.00	Stress rat'o (R)	0.10

K Coeff	EvB/P Coeff
0.886000	1.000980
4.640000	-4.669510
-13.320000	18.460100
14.720000	-236.824997
-5.600000	1214.880000
0.000000	-2143.570100

Analysis Codes
KRP 2 0

Visual Observations

EvB/P	Crack (EvB/P)	Crack (visual)	Error	CAF
24.97	0.900	0.872	-.028	1.000
26.23	0.941	0.947	0.005	1.000
28.03	0.996	1.010	0.014	1.000
32.61	1.118	1.119	0.001	1.000
37.42	1.224	1.203	-.021	1.000
40.54	1.285	1.261	-.024	1.000
47.82	1.405	1.381	-.024	1.000
50.85	1.447	1.426	-.022	1.000
55.56	1.508	1.481	-.027	1.000
58.77	1.545	1.525	-.020	1.000

Pmax (lbs)	EvB/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksiVin)
	25.44	0.9161	12656				
1127	25.73	0.9256	21925	0.0183	18984	9.616E-07	6.93
1078	26.00	0.9343	31640	0.0174	21722	8.018E-07	6.68
1033	26.27	0.9430	43646	0.0174	28109	6.203E-07	6.45
989	26.55	0.9518	59749	0.0179	37173	4.808E-07	6.22
947	26.85	0.9609	80820	0.0183	45759	3.998E-07	6.01
906	27.15	0.9701	105508	0.0185	52122	3.552E-07	5.79
867	27.46	0.9794	132941	0.0183	57804	3.164E-07	5.58
829	27.76	0.9884	163312	0.0178	64272	2.772E-07	5.38
794	28.06	0.9972	197213	0.0178	71996	2.477E-07	5.19
	28.37	1.0062	235308				

TABLE I35

Fatigue Crack Growth Data Associated with Figure I11 (Specimen F2GT1B)

AUTOMATED FATIGUE CRACK GROWTH RATE ANALYSIS

Specimen Id.	F2GT1B	Geometry	C(T)
Contract #	WB02115N	Orientation	T-L
Material	WELDALITE	Yield (ksi)	101.0
Temperature (F)	77	Modulus	10.9
Environment	Lab. air		

Specimen Dimensions (in)

Thickness	0.486	Notch depth	0.614
Width	2.997	Gage length	0.200
Height	3.600	Alpha ratio	1.000

Precrack Parameters

Pmax (lbs)	1271.0	Stress ratio (R)	0.10
Final a (in)	0.901	Kmax	8.50

Test Parameters

Initial a (in)	1.064	Initial K	4.40
K-gradient	2.50	Stress ratio (R)	0.10

K Coeff	EvB/P Coeff
0.886000	1.000980
4.640000	-4.669510
-13.320000	18.460100
14.720000	-236.824997
-5.600000	1214.880000
0.000000	-2143.570100

Analysis Codes		
KRP	2	0

Visual Observations

EvB/P	Crack (EvB/P)	Crack (visual)	Error	CAF
24.97	0.900	0.872	-.028	1.000
26.23	0.941	0.947	0.005	1.000
28.03	0.996	1.010	0.014	1.000
32.61	1.118	1.119	0.001	1.000
37.42	1.224	1.203	-.021	1.000
40.54	1.285	1.261	-.024	1.000
47.82	1.405	1.381	-.024	1.000
50.85	1.447	1.426	-.022	1.000
55.56	1.508	1.481	-.027	1.000
58.77	1.545	1.525	-.020	1.000

Comments

Date of test: 01-14-1992

TABLE I35 (Continued)

Specimen Id. F2GT18 — Page 1

Pmax (lbs)	E48/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksi√in)
	38.67	1.2491	493512				
784	39.13	1.2582	506627	0.0181	24618	7.364E-07	6.43
795	39.61	1.2673	518130	0.0185	19751	9.345E-07	6.58
806	40.11	1.2766	526378	0.0180	15063	1.195E-06	6.73
818	40.58	1.2853	533193	0.0171	13111	1.306E-06	6.88
830	41.04	1.2938	539489	0.0177	12495	1.413E-06	7.04
842	41.55	1.3029	545688	0.0186	11807	1.579E-06	7.20
854	42.09	1.3124	551296	0.0188	10345	1.815E-06	7.36
866	42.63	1.3217	556032	0.0176	8543	2.059E-06	7.53
879	43.11	1.3300	559839	0.0179	7405	2.422E-06	7.71
890	43.69	1.3396	563437	0.0178	6559	2.717E-06	7.87
903	44.18	1.3478	566398	0.0173	6017	2.876E-06	8.06
916	44.74	1.3569	569454	0.0186	5983	3.106E-06	8.24
929	45.33	1.3664	572381	0.0183	5491	3.334E-06	8.42
942	45.90	1.3752	574945	0.0177	4884	3.626E-06	8.62
955	46.47	1.3841	577265	0.0176	4461	3.954E-06	8.81
968	47.04	1.3929	579406	0.0176	4126	4.271E-06	9.01
982	47.63	1.4017	581391	0.0179	3816	4.681E-06	9.21
995	48.24	1.4107	583221	0.0178	3564	4.994E-06	9.42
1009	48.85	1.4195	584955	0.0183	3442	5.323E-06	9.64
1022	49.52	1.4291	586663	0.0172	2967	5.790E-06	9.84
1036	50.07	1.4367	587922	0.0165	2739	6.013E-06	10.07
1051	50.70	1.4455	589402	0.0198	3050	6.479E-06	10.30
1064	51.51	1.4565	590972	0.0193	2701	7.150E-06	10.53
1080	52.14	1.4648	592103	0.0169	2339	7.215E-06	10.78
1095	52.79	1.4734	593311	0.0186	2491	7.466E-06	11.04
1109	53.58	1.4834	594594	0.0185	2319	7.986E-06	11.27
1125	54.25	1.4919	595631	0.0176	2075	8.472E-06	11.55
1139	54.99	1.5010	596669	0.0182	2031	8.943E-06	11.80
1154	55.73	1.5100	597662	0.0172	1807	9.508E-06	12.06
1170	56.42	1.5182	598476	0.0177	1695	1.042E-05	12.34
1184	57.22	1.5277	599357	0.0181	1681	1.079E-05	12.60
1200	57.98	1.5363	600157	0.0179	1573	1.138E-05	12.90
1216	58.79	1.5456	600930	0.0186	1489	1.250E-05	13.20
1232	59.64	1.5550	601647	0.0185	1375	1.347E-05	13.50
1248	60.48	1.5641	602305	0.0181	1275	1.422E-05	13.82
1264	61.32	1.5731	602921	0.0172	1162	1.482E-05	14.12
1281	62.11	1.5813	603467	0.0178	1136	1.570E-05	14.45
1296	63.04	1.5909	604057	0.0182	1082	1.681E-05	14.76
1313	63.90	1.5995	604549	0.0181	980	1.845E-05	15.12
1329	64.86	1.6090	605036	0.0181	931	1.943E-05	15.45
1346	65.75	1.6176	605480	0.0179	867	2.070E-05	15.81
1363	66.73	1.6269	605903	0.0187	828	2.256E-05	16.17
1380	67.73	1.6363	606308	0.0180	760	2.367E-05	16.54
1397	68.68	1.6449	606663	0.0178	712	2.496E-05	16.93
1414	69.71	1.6541	607021	0.0177	669	2.651E-05	17.29
1432	70.69	1.6627	607332	0.0181	709	2.556E-05	17.70
1448	71.80	1.6722	607730	0.0180	670	2.692E-05	18.08
1467	72.81	1.6807	608001	0.0183	573	3.185E-05	18.53

Specimen Id. F2GT18 — Page 2

Pmax (lbs)	E48/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksi√in)
1483	74.00	1.6905	608303	0.0185	548	3.3[illegible]E-05	18.93
1502	75.09	1.6992	608549	0.0178	484	3.6[illegible]E-05	19.38
1518	76.24	1.7083	608788	0.0174	459	3.[illegible]E-05	19.80
1536	77.31	1.7166	609008	0.0169	402	4.1[illegible]E-05	20.24
1552	78.45	1.7251	609190	0.0166	362	4.5[illegible]E-05	20.66
1571	79.53	1.7332	609370	0.0192	386	4.9[illegible]E-05	21.17
1589	81.07	1.7443	609576	0.0202	364	5.5[illegible]E-05	21.63
1609	82.36	1.7534	609734	0.0183	303	6.0[illegible]E-05	22.19
1628	83.70	1.7627	609879	0.0189	277	6.8[illegible]E-05	22.72
1645	85.13	1.7723	610011	0.0179	240	7.4[illegible]E-05	23.22
1664	86.38	1.7806	610119	0.0172	228	7.5[illegible]E-05	23.76
1682	87.77	1.7895	610239	0.0182	240	7.5[illegible]E-05	24.29
1700	89.23	1.7987	610359	0.0181	228	7.9[illegible]E-05	24.84
1719	90.68	1.8077	610467	0.0186	216	8.6[illegible]E-05	25.43
1738	92.29	1.8173	610575	0.0196	216	9.0[illegible]E-05	26.04
1757	93.98	1.8272	610683	0.0193	203	9.5[illegible]E-05	26.66
1776	95.63	1.8366	610778	0.0176	178	9.[illegible]E-05	27.27
1796	97.09	1.8448	610861	0.0185	166	1.[illegible]E-04	27.95
1814	99.00	1.8551	610944	0.0201	153	1.[illegible]E-04	28.59
1835	100.84	1.8649	611013	0.0202	133	1.[illegible]E-04	29.34
1855	102.87	1.8753	611076	0.0203	116	1.[illegible]E-04	30.07
1874	104.84	1.8852	611130	0.0179	91	1.[illegible]E-04	30.77
1895	106.49	1.8932	611167	0.0191	81	2.[illegible]E-04	31.59
1918	108.82	1.9043	611211	0.0260	88	2.[illegible]E-04	32.51
1949	112.09	1.9192	611255	0.0345	91	3.[illegible]E-04	33.78
2004	116.58	1.9388	611301	0.0579	96	6.[illegible]E-04	36.14
	126.20	1.9771	611351				

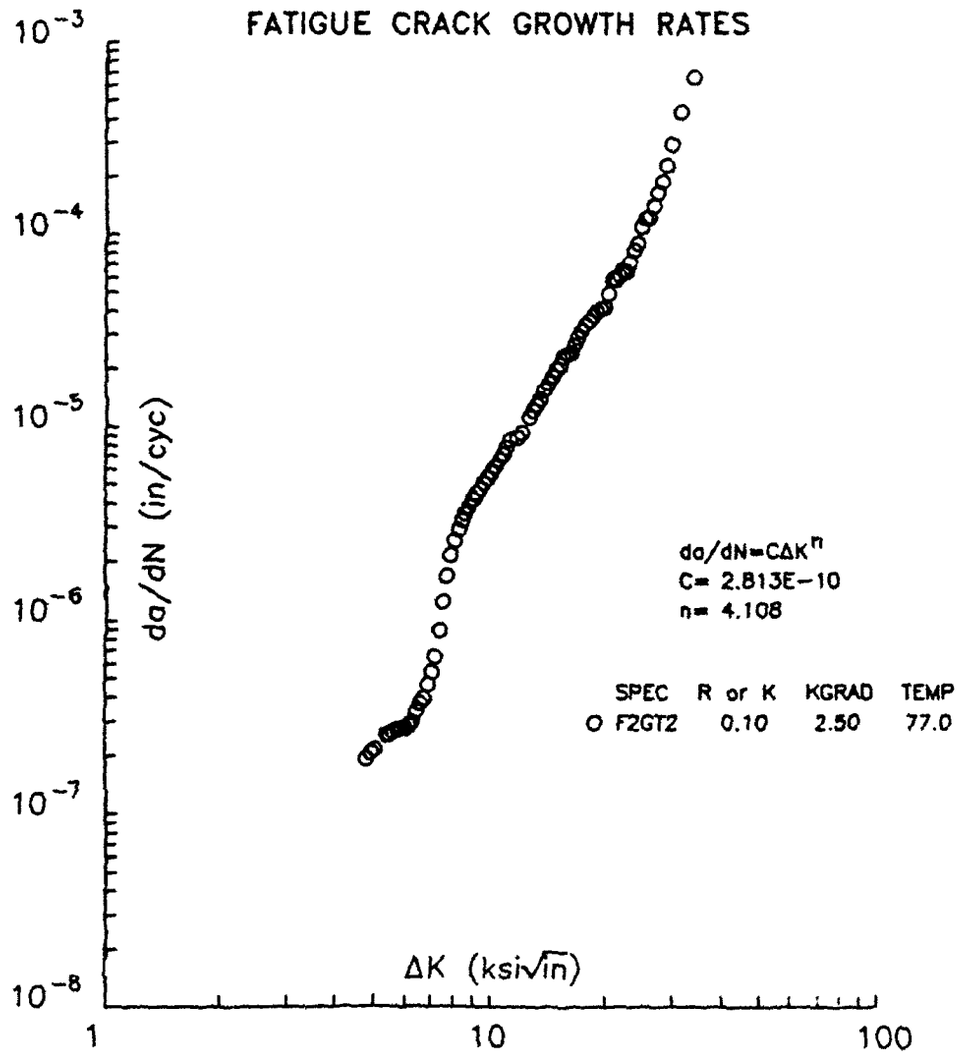


Figure I12. Fatigue Crack Growth Rate Data for 2095-T8 0.5 Inch Thick Plate (T-L orientation, KGRAD 2.50). Northrop.

TABLE I36

Fatigue Crack Growth Data Associated with Figure I12 (Specimen F2GT2)

AUTOMATED FATIGUE CRACK GROWTH RATE ANALYSIS

Specimen Id.	F2GT2	Geometry	C(T)
Contract #	WB02115N	Orientation	T-L
Material	WELDALITE	Yield (ksi)	101.0
Temperature (F)	77	Modulus	10.8
Environment	Lab. air		

Specimen Dimensions (In)

Thickness	0.494	Notch depth	0.605
Width	2.999	Gage length	0.200
Height	3.600	Alpha ratio	1.000

Precrack Parameters

Pmax (lbs)	1166.0	Stress ratio (R)	0.10
Final a (in)	0.665	Kmax	6.21

Test Parameters

Initial a (in)	0.741	Initial K	4.60
K-gradient	2.50	Stress ratio (R)	0.10

K Coeff	EvB/P Coeff
0.886000	1.000980
4.640000	-4.569510
-13.320000	18.460100
14.720000	-236.824997
-5.600000	1214.880000
0.000000	-2143.570100

Analysis Codes

KRP	1	0

Visual Observations

EvB/P	Crack (EvB/P)	Crack (visual)	Error	CAF
21.66	0.785	0.795	0.010	1.006
23.23	0.844	0.842	-.002	1.005
28.22	1.003	0.990	-.014	1.001
34.19	1.154	1.151	-.003	0.998
36.97	1.213	1.219	0.005	0.997
46.28	1.377	1.379	0.002	0.993

Comments

Date of test: 02-12-1992

TABLE I36 (Continued)

Specimen Id. F2GT2 — Page 1

Pmax (lbs)	E48/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksi√in)
	21.74	0.7885	326137				
878	22.13	0.8035	405878	0.0239	122269	1.957E-07	4.76
895	22.36	0.8124	448406	0.0178	85112	2.094E-07	4.91
908	22.60	0.8213	490989	0.0177	81995	2.162E-07	5.02
	22.84	0.8301	530401				
	23.15	0.8415	557757				
951	23.34	0.8484	583768	0.0154	59790	2.583E-07	5.39
964	23.59	0.8570	617547	0.0175	67507	2.585E-07	5.49
978	23.84	0.8658	651275	0.0178	66576	2.674E-07	5.62
992	24.10	0.8748	684123	0.0177	64210	2.749E-07	5.74
1007	24.35	0.8835	715486	0.0174	62704	2.768E-07	5.87
1022	24.61	0.8921	746827	0.0176	62694	2.804E-07	6.01
1037	24.88	0.9011	778180	0.0178	61327	2.899E-07	6.14
1052	25.15	0.9099	808154	0.0169	55847	3.018E-07	6.27
1068	25.39	0.9179	834027	0.0171	50008	3.423E-07	6.42
1083	25.68	0.9270	858162	0.0184	49275	3.744E-07	6.56
1100	25.97	0.9364	883302	0.0183	45915	3.990E-07	6.71
1116	26.26	0.9453	904077	0.0175	37374	4.673E-07	6.87
1133	26.54	0.9538	920676	0.0171	31500	5.435E-07	7.02
1150	26.82	0.9625	935577	0.0181	27552	6.575E-07	7.18
1168	27.14	0.9719	948228	0.0193	21664	8.924E-07	7.35
1186	27.47	0.9818	957241	0.0184	14654	1.254E-06	7.52
1204	27.77	0.9903	962882	0.0171	10089	1.698E-06	7.70
1223	28.07	0.9989	967330	0.0182	8338	2.182E-06	7.88
1240	28.40	1.0085	971220	0.0175	6790	2.579E-06	8.04
1259	28.69	1.0164	974120	0.0163	5587	2.926E-06	8.23
1276	28.99	1.0248	976807	0.0170	5179	3.280E-06	8.40
1295	29.30	1.0334	979300	0.0175	4905	3.567E-06	8.59
1314	29.64	1.0423	981712	0.0179	4606	3.882E-06	8.78
1334	29.97	1.0513	983906	0.0178	4206	4.226E-06	8.98
1354	30.31	1.0601	985918	0.0180	3983	4.509E-06	9.19
1374	30.66	1.0693	987889	0.0177	3677	4.803E-06	9.39
1394	31.00	1.0778	989594	0.0168	3286	5.103E-06	9.60
1415	31.33	1.0860	991174	0.0174	3197	5.429E-06	9.82
1435	31.69	1.0951	992791	0.0184	3168	5.811E-06	10.04
1457	32.07	1.1044	994342	0.0181	2901	6.237E-06	10.27
1479	32.44	1.1132	995692	0.0172	2542	6.785E-06	10.50
1500	32.79	1.1217	996884	0.0172	2360	7.285E-06	10.74
1523	33.17	1.1304	998052	0.0180	2279	7.893E-06	10.98
1545	33.57	1.1397	999163	0.0184	2132	8.632E-06	11.23
1593	33.97	1.1488	1000183	0.0360	4047	8.883E-06	11.76
1617	35.18	1.1756	1003210	0.0357	3811	9.358E-06	12.03
1663	35.59	1.1845	1003995	0.0166	1463	1.136E-05	12.56
1688	35.96	1.1922	1004673	0.0168	1365	1.231E-05	12.85
1711	36.39	1.2013	1005360	0.0180	1369	1.312E-05	13.12
1738	36.83	1.2102	1006043	0.0193	1363	1.415E-05	13.45
1762	37.34	1.2206	1006722	0.0180	1147	1.571E-05	13.73
1791	37.72	1.2282	1007189	0.0172	1017	1.696E-05	14.08

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Pmax (lbs)	E48/P	a (in)	N (X1)	Δa (in)	ΔN (X1)	Δa/ΔN (in/cyc)	ΔK (ksi√in)
1816	38.21	1.2378	1007739	0.0185	1006	1.842E-05	14.38
1842	38.67	1.2467	1008195	0.0168	842	1.995E-05	14.70
1869	39.08	1.2546	1008581	0.0172	808	2.135E-05	15.04
1895	39.58	1.2640	1009003	0.0182	778	2.337E-05	15.36
1922	40.05	1.2728	1009359	0.0168	693	2.428E-05	15.71
1948	40.50	1.2808	1009696	0.0163	660	2.467E-05	16.05
1976	40.95	1.2891	1010019	0.0175	645	2.718E-05	16.40
2004	41.48	1.2984	1010341	0.0189	633	2.991E-05	16.77
2034	42.03	1.3080	1010651	0.0187	583	3.210E-05	17.17
2065	42.56	1.3171	1010924	0.0184	533	3.452E-05	17.58
2095	43.11	1.3264	1011184	0.0180	495	3.646E-05	17.98
2124	43.64	1.3351	1011419	0.0171	444	3.856E-05	18.39
2154	44.15	1.3435	1011628	0.0170	419	4.059E-05	18.79
2185	44.69	1.3521	1011838	0.0183	431	4.236E-05	19.23
2215	45.30	1.3618	1012059	0.0186	435	4.284E-05	19.66
2254	45.88	1.3707	1012273	0.0216	430	5.035E-05	20.22
2281	46.70	1.3834	1012489	0.0191	318	5.992E-05	20.61
2317	47.12	1.3898	1012591	0.0141	238	5.919E-05	21.14
2345	47.63	1.3975	1012727	0.0169	270	6.259E-05	21.56
2375	48.26	1.4067	1012861	0.0178	268	6.640E-05	22.00
2408	48.84	1.4153	1012995	0.0175	267	6.558E-05	22.50
2441	49.47	1.4242	1013128	0.0185	254	7.262E-05	23.01
2476	50.15	1.4337	1013249	0.0191	230	8.337E-05	23.55
2510	50.84	1.4434	1013358	0.0187	204	9.139E-05	24.11
2547	51.51	1.4524	1013454	0.0189	171	1.109E-04	24.70
2582	52.25	1.4623	1013528	0.0191	155	1.228E-04	25.27
2622	52.96	1.4715	1013609	0.0199	160	1.242E-04	25.92
2660	53.79	1.4821	1013688	0.0210	147	1.426E-04	26.56
2703	54.62	1.4925	1013756	0.0213	126	1.691E-04	27.29
2741	55.51	1.5035	1013815	0.0196	102	1.921E-04	27.94
2789	56.23	1.5121	1013859	0.0212	91	2.340E-04	28.77
2840	57.29	1.5247	1013905	0.0288	96	3.017E-04	29.68
2925	58.71	1.5409	1013954	0.0441	100	4.411E-04	31.23
3056	61.26	1.5688	1014005	0.0715	107	6.679E-04	33.69
	65.57	1.6124	1014061				

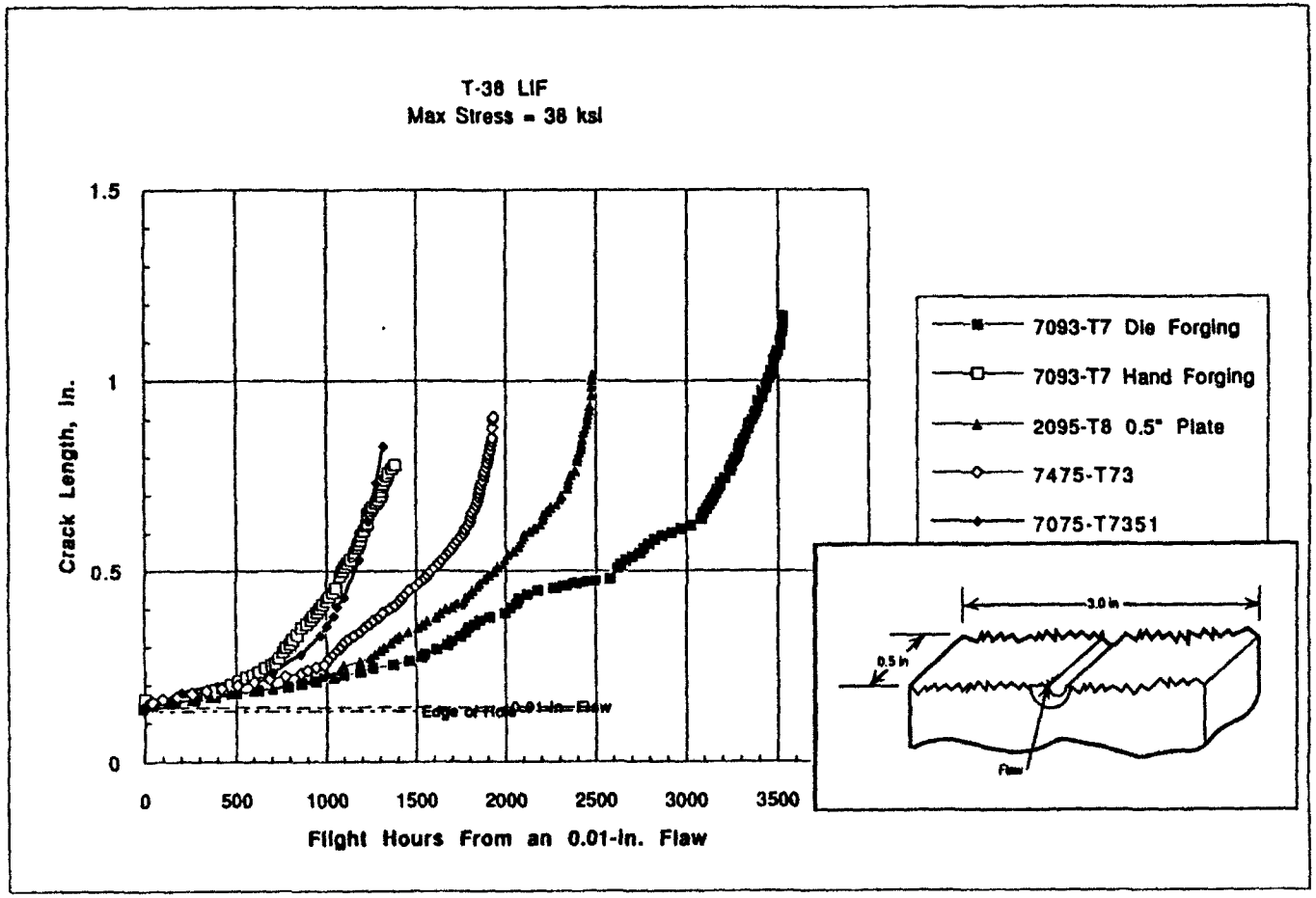

Figure I13. T38 LIF Spectrum Fatigue Crack Growth Rate Data for 2095-T8 0.5 Inch Plate (Max Stress = 38 Ksi, Flaw = 0.01 inch). Northop.

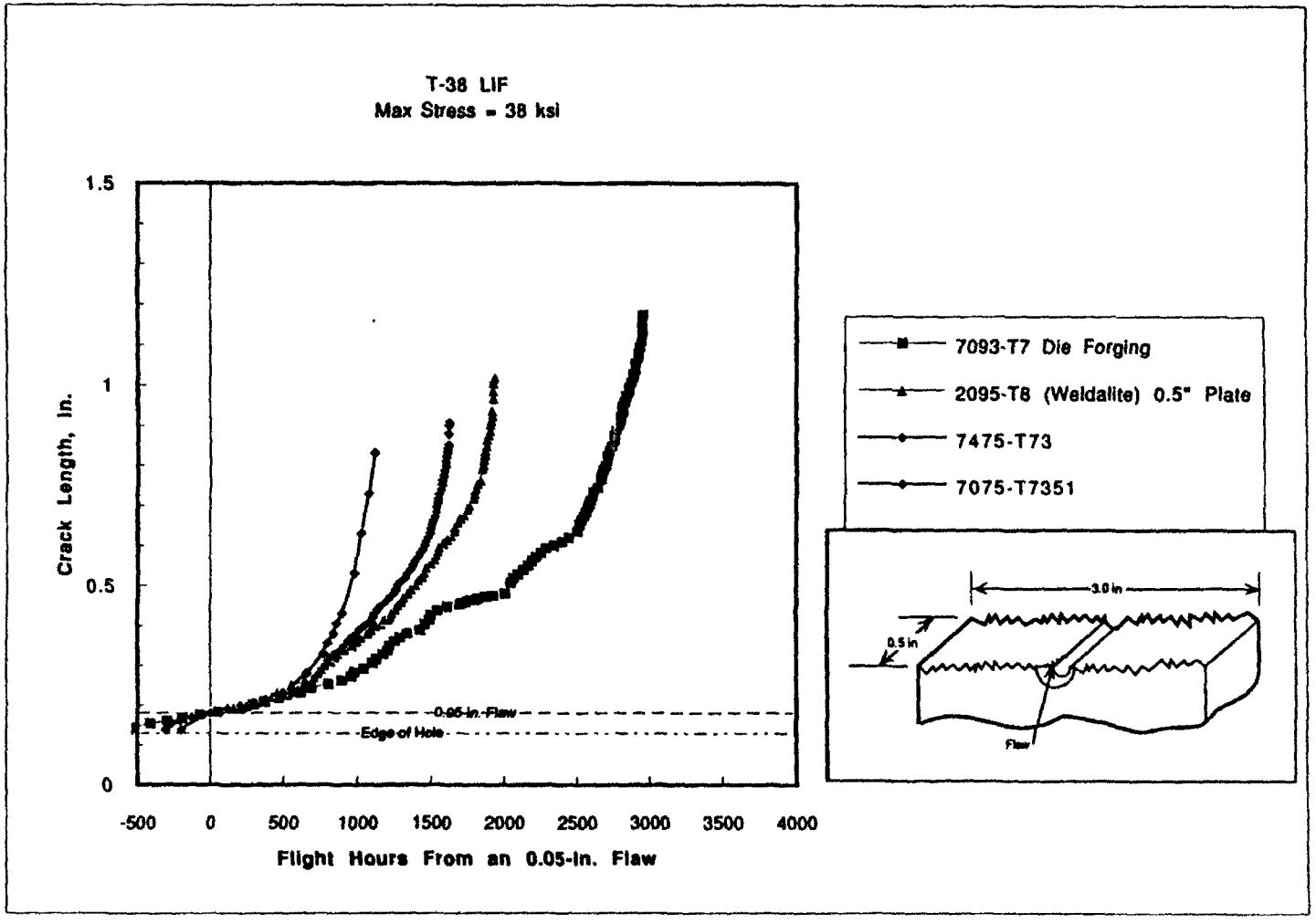

Figure I14. T38 LIF Spectrum Fatigue Crack Growth Rate Data for 2095-T8 0.5 Inch Plate (Max Stress = 38 Ksi, Flaw = 0.05 inch). Northop.

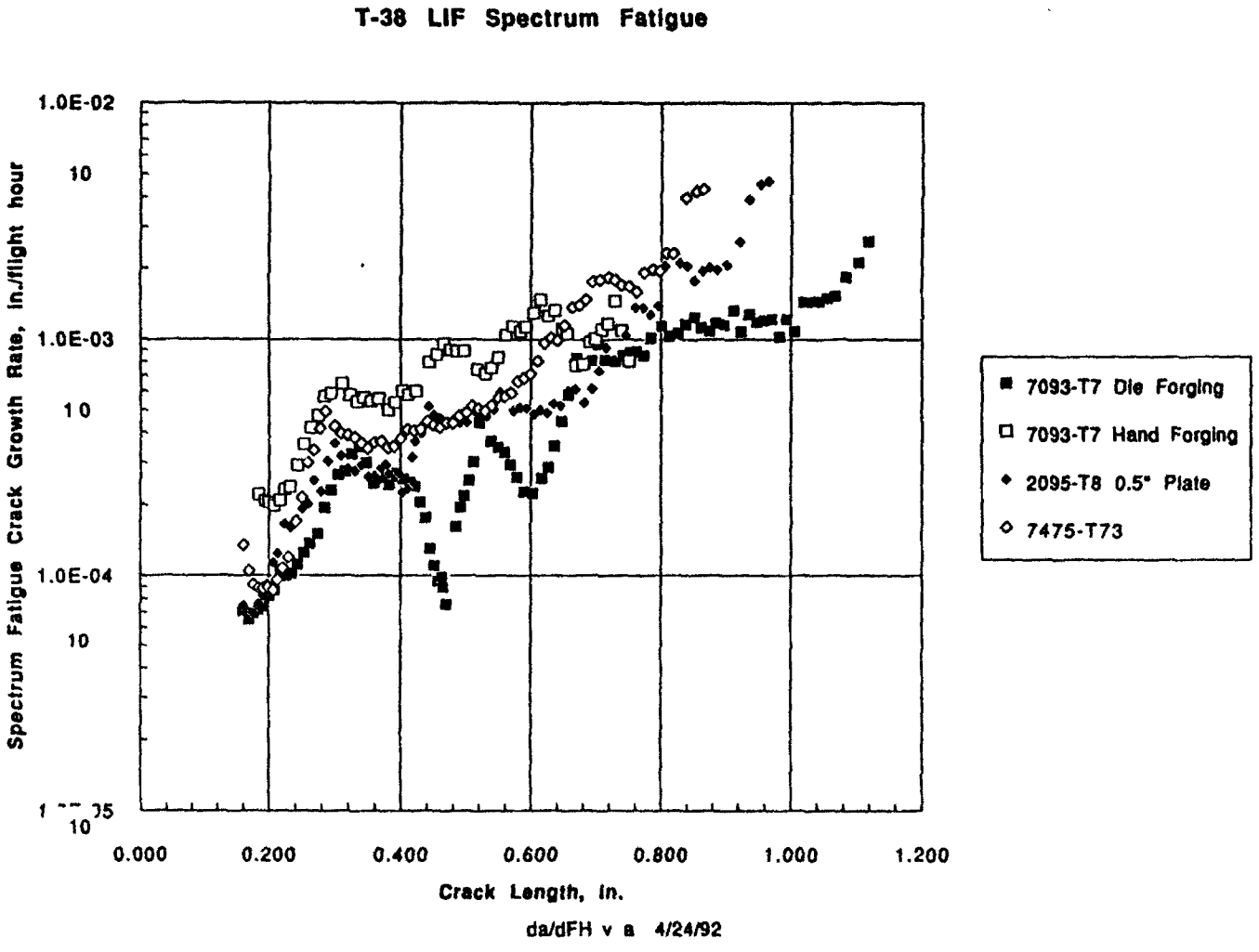

Figure I15. T38 LIF Spectrum Fatigue Crack Growth Rate Data for 2095-T8 0.5 Inch Plate (Max Stress = 38 Ksi). Northop.

SECTION V

CONCLUSIONS

Seven aerospace laboratories participated in generating data on the 2095-T8 0.5-inch-thick plate for the cooperative test program. These data combined with previous interim reports on the Air Force/Industry Cooperative Test Program on Advanced Aluminum Alloys provide an extensive data base on aluminum-lithium alloys.

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